Review of Prospectus for Celgar Pulp Mill Expansion

Prepared by:
Steering Committee of the
Major Project Review Process
July 1990

Ministry of Regional and Economic Development
Ministry of Environment

91-02337/

Canadian Cataloguing in Publication Data

British Columbia. Steering Committee of the Major
Project Review Process
Review of prospectus for Celgar pulp mill expansion

Co-published by Ministry of Environment.
ISBN 0-7726-1190-4

1. Wood-pulp industry - Environmental aspects -
British Columbia - Castlegar. 2. Celgar Pulp Company.
3. Pulp mills - Environmental aspects -
British Columbia - Castlegar. I. British Columbia.
Ministry of Regional and Economic Development. II
British Columbia. Ministry of Environment. III. Title.

TD195.P37B75 1990 676'.12 090-092223-0

PREAMBLE

This report is based on an examination of Celgar's Prospectus documents for the expansion of the company's pulp mill near Castlegar, the additional information provided by the company during the Prospectus review period, and the submissions made by the general public and government agencies with regard to the Prospectus documents.

OVERVIEW

Celgar Pulp Company (Celgar, the company) proposes to expand its bleached kraft pulp mill on the Columbia River, at Castlegar, British Columbia. The company operates as a joint venture between CITIC B.C. Inc. and Power Consolidated (China) Pulp Inc.

According to the company, the modernization of the Celgar pulp mill will result in an increase in the production capacity of the mill from 560 ADt/d (air-dried tonnes per day) to 1,200 ADt/d of bleached kraft pulp. The project includes the construction of a new, continuous fibre line and a modern bleaching plant with expanded capacity to accommodate the fibre line. The existing fibre line will continue to operate. New technology is proposed in the bleaching plant, in order to reduce the use of chlorine in the pulping process. With a construction period in excess of two years, completion of the project is targeted for early 1993.

The project is being subjected to British Columbia's Major Project Review Process (MPRP). The company filed environmental and socio-economic impact reports as Prospectus documents with the Major Project Steering Committee (MPSC) in December of 1989.

Approximately 26 provincial and federal government agencies were invited to review these documents. The reports were also made available to the public at local government offices and public libraries in the Kootenay region. Government agencies of the United States and the States of Washington and Oregon were also invited to provide comments on Celgar's expansion project. The company also held two open houses, in Castlegar and Nelson.

Upon completion of the Prospectus Stage review, the MPSC has determined that a Stage II report by the company is necessary to address a number of concerns identified by both the public and reviewing government agencies. It was generally found that, while the Prospectus documents presented the processes and technologies to be employed in the new mill in some detail, there was insufficient information on the impacts of emissions, effluent discharges and production activities on the receiving environment.

The Stage II report is to provide additional information regarding the following:

- impacts of emissions from the expanded mill on air quality;
- impacts of effluent discharges from the expanded mill on receiving waters;
- availability of surplus wood chips; and
- options for transporting additional wood chips to the mill.

Terms of reference for the Stage II report comprise Appendix A.

The Stage II Report will be the Focus of Public Hearings

In view of public and agency concerns over the potential environmental impacts of the project, an independent review panel has been formed to review the company's Stage II report, as well as submissions from the public and government agencies, and to hold public hearings.

This panel has been established under Section 7 of the British Columbia Environment Management Act and pursuant to the federal Environmental Assessment and Review Process (EARP) Guidelines Order. The federal Department of Fisheries and Oceans (DFO) is the initiating department under the EARP order.

Terms of reference for the panel, approved by the provincial and federal Ministers of the Environment, comprise Appendix B.

TABLE OF CONTENTS

I. PROJECT DESCRIPTION

I.1 Celgar's Ownership
I.2 Background to the Upgrade and Expansion Project

II. THE MAJOR PROJECT REVIEW PROCESS

II.1 What does Approval-in-Principle Mean?
II.2 The Major Project Steering Committee

III. HISTORY OF CELGAR PROJECT REVIEW

III.1 Prospectus Distribution and Review
III.2 Other Opportunities for Information-Sharing
III.3 The Decision of the MPSC Was Announced in April, 1990

IV. SUMMARY OF PUBLIC AND AGENCY COMMENTS

IV.1 Public Comments
IV.2 Provincial Government Agency Comments
IV.3 Federal Government Agency Comments

V. CONCLUSIONS AND RECOMMENDATIONS

V.1 A Stage II Report is Required
V.2 An Independent Review Panel Is Needed
V.3 Construction Will Be Restricted Until the Review is Complete
V.4 Other Comments and Recommendations Regarding the Project
V.5 Comments and Recommendations Regarding the Review Process

APPENDICES

APPENDIX A	Information Requirements for Stage II Report
APPENDIX B	Independent Review Panel Terms of Reference
APPENDIX C	Supplementary Information Supplied by Celgar
APPENDIX D	Preliminary Archaeology Assessment
APPENDIX E	Provincial Government Agency Comments
APPENDIX F	Federal Government Agency Comments
APPENDIX G	Socio-Economic Impact Study Terms of Reference

I. PROJECT DESCRIPTION*

Celgar Pulp Company is proposing a $630 million modernization and expansion of its bleached kraft pulp mill near Castlegar. The mill's current capacity is about 190,000 tonnes per year of air-dried softwood bleached market kraft pulp. The proposed expansion would increase capacity to 420,000 tonnes per year and enable the mill to meet Government of British Columbia air and water emission criteria. The project is also designed to allow the existing mill to continue to operate throughout the construction period.

The project includes the construction of a new, continuous fibre line and a modern bleaching plant with expanded capacity to accommodate the fibre line. New technology is proposed in the bleaching plant, in order to reduce the use of chlorine in the pulping process. Anticipating a construction period in excess of two years, Celgar is targeting early 1993 as a completion date.

Celgar's customers are typically producers of fine printing and writing papers and computer paper in Germany, China and Australia, as well as within North America. According to Celgar executives, the company's product is purchased primarily for its purity, strength and whiteness.

The company has been the single largest employer in the Castlegar area for almost 30 years. With approximately 380 full-time employees, it is estimated that some 1,000 jobs in the region are directly and indirectly related to the company's operations. Celgar's Prospectus documents indicate that the mill expansion project will generate up to 1,400 construction jobs (peak construction period) and an additional 30 long term jobs in expanded operations.

I.1 Celgar's Ownership

Celgar Pulp Company operates as a joint venture, with CITIC B.C. Inc. and Power Consolidated (China) Pulp Inc. sharing the ownership equally. The operations were purchased from Westar Group in October, 1986.

---

* This chapter is based on information provided by Celgar Pulp Company in its Prospectus documents.

CITIC B.C. Inc. is a wholly-owned subsidiary of CITIC Canada Inc., which in turn is wholly-owned by China International Trust and Investment Corporation (CITIC China). All of the shares of CITIC China are owned by the Peoples Republic of China.

Power Consolidated (China) Pulp Inc. is a joint venture owned equally by Power Corporation of Canada and Stone-Consolidated Inc., each with head offices in Montreal, Quebec.

I.2 Background to the Upgrade and Expansion Project

The Celgar mill started production in 1961. For the past number of years, due to the age and repair of the mill, Celgar has failed to achieve provincially-mandated effluent discharge and air emission standards. Based on financial consideration, the British Columbia Ministry of Environment issued a variance order to Westar Group (the previous mill owner) in 1986, permitting the mill to improve its environmental situation to Level A (1977) Control Objectives over a period of 10 years. This agreement was transferred to the new owners in the same year.

The new owners launched a modernization program in April, 1988. The program focused on improving the operation of the mill's recovery boiler. However, the modifications did not achieve the required environmental improvements.

In 1989, the British Columbia Ministry of Environment proposed a requirement that all mills in the province reduce AOX (chlorinated organics) discharges to 1.5 kg/T (kilograms per tonne of pulp produced) by 1994. The Ministry's proposal included an interim target of 2.5 kg AOX/T by December 31, 1991. These objectives cannot be met without modernizing Celgar's plant. The company has estimated the cost of meeting Level A (1977) Control Objectives, including the proposed amendments, to be between $110 and $150 million.

Celgar representatives have stated that there would be "little or no economic return" from an environmental upgrade and that "the resulting mill would be of uneconomic size and its economic life would remain vulnerable." Furthermore, the company has indicated that at this time, an environmental upgrade without a major capacity expansion cannot be financed either by income from operations or by external borrowing. Consequently, a major capacity expansion is proposed in tandem with the environmental upgrade.

II. THE MAJOR PROJECT REVIEW PROCESS

The main objective of the MPRP is to provide for the comprehensive and timely assessment of the environmental and socio-economic impacts of major projects not examined under existing integrated review processes. It is non-legislated working policy supported by the Environment and Land Use Act.

The MPRP involves the solicitation of comments on proposed major projects from the public as well as concerned government agencies at the federal, provincial and local levels. The comments are in response to technical reports which the project proponent is required to submit. Initially, public input is solicited in the form of written comments. However, at a later stage, the establishment of an independent review panel to conduct public hearings is one of a number of options for collecting further public input.

The MPRP can involve four-stages: Prospectus, Stage I, Stage II, and Permitting and Licensing. The MPSC can reach one of three possible decisions at the end of each of the first two stages:

- the project is rejected;
- the project requires further review; and
- the project receives Approval-in-Principle.

At the end of the Stage II review, the project is either Approved-in-Principle or rejected by the British Columbia Cabinet Committee on Sustainable Development (CCSD).

For a Stage II review, the CCSD may instruct the MPSC to provide for further public involvement by way of one of the following:

- appointment of an individual or a panel to conduct a fact-finding mission in order to verify and/or supplement existing information;
- appointment of a mediator/facilitator to meet separately with the affected parties to negotiate a mutually acceptable solution; or
- appointment of an independent review panel to hold public hearings in order to make recommendations to the CCSD.

II.1 What Does Approval-in-Principle Mean?

A project must receive Approval-in-Principle before applications for provincial permits and licenses can be processed. Approval-in-Principle for a major project is granted after all of the project's potentially significant environmental and socio-economic impacts have been identified and addressed by acceptable mitigation or impact management proposals.

Because all major issues of concern should be resolved before a project receives Approval-in-Principle, the likelihood that the permitting and licensing process will be impeded should be significantly reduced.

II.2 The Major Project Steering Committee

The MPRP is administered by the MPSC, co-chaired by the British Columbia Ministries of Regional and Economic Development, and Environment. The MPSC also includes representatives from: the British Columbia Ministries of Forests; Energy, Mines and Petroleum Resources; Municipal Affairs, Recreation and Culture; as well as Environment Canada and the Federal Environmental Assessment Review Office.

III. HISTORY OF CELGAR PROJECT REVIEW

The company began planning the modernization and expansion of its Castlegar operation during the summer of 1989.

In August, 1989, Celgar initiated the permit application process in a meeting at Castlegar with regional staff of the British Columbia Ministry of Environment. It was determined that there were significant environmental issues to be addressed. Ministry and company officials agreed on terms of reference for an Environmental Impact Statement (EIS).

In October, 1989, the company was informed that the MPRP would be established in the near future, and that its project would be subject to the process. The company was also informed that it could submit its EIS in lieu of a Prospectus. However, information on social and economic impacts were not contained in the EIS and, therefore, the company prepared a second Prospectus document dealing with socio-economic impacts.

The two Prospectus documents were received by the MPSC in December, 1989. They were advertised and distributed by the company for public viewing on December 29, 1989, and January 5, 1990, respectively.

III.1 Prospectus Distribution and Review

Approximately 150 copies of the Prospectus documents were distributed for public review throughout the region bordered by Nelson to the north and east, Trail to the south and Castlegar to the west.

January 26, 1990, was initially established as the deadline for written public comments. This was later extended to February 16, 1990, because of the time consumed by the holiday season. Additional copies of the Prospectus documents were made available on request to the communities of Castlegar, Nelson, Revelstoke and Nakusp. The latter two communities had not been included in the original circulation.

Copies of the Prospectus documents were sent to 18 provincial and four federal agencies in Canada, as well as two federal and two state agencies (Washington and Oregon) in the United States. The majority of affected agencies filed reviews and recommendations with the MPSC by March 9, 1990.

Due to postal delays public comments were received for some time after the February 16, 1990, deadline. The MPSC made every effort to consider all submissions received prior to March 22, 1990.

On March 5, 1990, the British Columbia Ministry of Environment prepared a preliminary list of concerns regarding the project. The Coordinators of the MPRP reviewed these preliminary concerns with Celgar representatives in the same week. On March 12, 1990, Celgar submitted additional information in partial response to the preliminary concerns. Celgar's response comprises Appendix C.

The company was also required by the British Columbia Ministry of Municipal Affairs, Recreation and Culture to undertake a preliminary archaeological impact assessment under the British Columbia Archaeological Impact Assessment Guidelines. A copy of the resulting study is included in Appendix D.

III.2 Other Opportunities for Information-Sharing

At the request of members of the local community, representatives of the MPSC met with interested parties in Castlegar to explain the MPRP, distribute guidelines and answer any questions regarding the process and how it relates to the Celgar expansion project. Meetings were held on February 21 and 22, 1990, with the Celgar Expansion Advisory Group, the Coalition for Information on Pulp Mill Expansion and the company.

The company held open houses in Castlegar on February 28, 1990, and in Nelson on March 9, 1990. Members of the MPSC, or designates, were at both open houses.

III.3 The Decision of the MPSC was Announced in April 1990

In April, 1990, the MPSC decided that the company should submit a Stage II report, providing additional information on:

- impacts of emissions from the expanded mill on air quality;
- impacts of effluent discharges from the expanded mill on receiving waters;
- sources and availability of residual chips; and
- options for transporting additional wood chips to the mill.

It was also decided that review of the Stage II report, and public and government agency comments, should be undertaken by an independent federal-provincial panel which would conduct public hearings. On April 20, 1990, the decision of the MPSC was announced by the Honourable John Reynolds, Minister of Environment. On June 28, 1990, the Honourable John Reynolds and the Honourable Robert de Cotret, federal Minister of Environment, announced Terms of Reference and appointed members for a federal-provincial panel.

IV. SUMMARY OF PUBLIC AND AGENCY COMMENTS

The MPSC reviewed all written submissions providing comments on Celgar's Prospectus documents. Each issue and concern identified by individuals, groups and agencies was considered in the formulation of the MPSC's recommendations, whether raised by one respondent or many.

IV.1 Public Comments on the Celgar Prospectus Documents

A two-volume compendium of 341 public responses has been distributed to the locations where the Prospectus documents were available for public viewing. The compendium is comprised of all the public submissions received by the MPSC prior to March 1, 1990.

The majority of written submissions indicated a cautious desire to see the Celgar expansion project proceed, subject to the company adequately addressing some major concerns. Overall, the most commonly cited concerns were that:

- a number of environmental impacts, particularly those relating to the emission of "greenhouse gases" and sulphur dioxide, have not been satisfactorily addressed;
- the increase in chip truck traffic may have substantial negative impact on public safety and air quality and that the potential for using other transportation modes has not been fully explored;
- the expansion may result in an increase in the harvest of timber in the region; and
- the public has not been provided sufficient opportunity for participation in project review and decision-making.

The most frequently cited project-related concern pertained to the increase in chip truck traffic. It should be noted that just over 50% of the submissions received came from communities north of Castlegar, in the Slocan Valley and Nelson areas, where transportation impacts are likely to be most significant.

Most submissions called for further information and review, and increased public participation. Public hearings were specifically called for in some 22 submissions, including the majority of submissions from special interest groups.

About 60 submissions categorically opposed approval of the project. The primary reasons for opposition included: concerns about acid rain, global warming and the greenhouse effect; the feeling that the current annual allowable cut in the region is not sustainable and that the mill expansion would result in pressure on government to permit increased logging activity; and lack of confidence in regulatory bodies' willingness and capability to enforce environmental standards.

Just under 30 submissions received during the review period fully endorsed the project, and requested immediate approval. In April 1990, after the decision to establish an independent review panel was announced, a petition requesting the British Columbia Minister of Environment to work towards resolution of outstanding issues as expeditiously as possible was circulated in Castlegar and surrounding communities. Over 7,300 signatures appeared on this petition.

IV.2 Provincial Government Agency Comments

Provincial agencies reviewed Celgar's Prospectus documents with respect to issues that fall within provincial jurisdiction. A list of provincial statutes that may apply is included on pages 20 to 23 of the MPRP Guidelines. A complete set of provincial government agency comments comprise Appendix E. A summary of these comments is presented in Table 1.

For the most part, the issues and concerns identified by provincial government agencies were similar to the comments of the public. While comments from the public generally led to recommendations for further public review, provincial agency comments focused somewhat more on the need for the company to collect additional data, improve the methods and models used to estimate environmental and socio-economic impacts, and develop more comprehensive mitigation and impact management proposals.

The Ministry of Environment specifically recommended that "...better documentation of predicted effluent and emission quality is needed, and the proponent should expect to meet permit limits reasonably achieved by Best Available Control Technology (BACT). Prediction of environmental impact should be based on BACT, rather than 1977 Control Objectives for Level A if BACT is feasible and produces better effluent or emission quality."

TABLE 1

SUMMARY OF PROVINCIAL AGENCY COMMENTS

AGENCY	RECOMMENDATION
Ministry of Environment	Additional information and further review required.
Ministry of Transportation and Highways	Approval-in-Principle recommended subject to company providing additional information regarding chip transport options.
Ministry of Forests	Additional information and further review required.
Ministry of Agriculture	Approval-in-Principle recommended subject to company providing additional information on effluent and waste water impacts on wildlife and food safety.
Ministry of Municipal Affairs, Recreation and Culture Archaeology Branch	Approval-in-Principle recommended subject to monitoring excavation for effluent treatment plant and recovery and analysis of archaeological remains inadvertently exposed by excavation.
Ministry of Municipal Affairs, Recreation and Culture Development Services Branch	Approval-in-principle recommended subject to company completing assessment of the socio-economic impacts of the project on the region, company participating on a socio-economic impact monitoring committee and company agreeing to cooperate in impact mitigation activities prescribed by the committee.

TABLE 1 (cont'd)

SUMMARY OF PROVINCIAL AGENCY COMMENTS

AGENCY	RECOMMENDATION
Ministry of Energy, Mines and Petroleum Resources	Approval-in-Principle recommended subject to company agreeing to explore opportunities for power conservation and on-site power generation and company obtaining Energy Project Certificate if necessary.
Ministry of Regional and Economic Development	Approval-in-Principle recommended subject to company participating on a socio-economic impact monitoring committee and evaluating chip transport options.
Ministry of Government Management Services and Women's Programs	No recommendations made but concerns expressed about environmental impacts.
Ministry of Parks	No recommendations made but concerns expressed about impacts of increased industrialization on tourism and recreation in region.
Ministry of Education	No recommendations made.
Ministry of Social Services and Housing	Approval-in-Principle recommended subject to company committing to maximize use of local labour force.
Ministry of Health	Additional information and further review required.
Ministry of Native Affairs	No recommendations made but company asked to consult with the Kootenay Indian Area Council.

IV.3 Federal Government Agency Comments

Environment Canada acted as coordinator and conduit to the MPRP for the federal agency review. Participating federal agencies included Environment Canada (Environmental Protection, Atmospheric Environment Service, Canadian Wildlife Service and Inland Waters), the Department of Fisheries and Oceans, Indian and Northern Affairs Canada and Health and Welfare Canada. The Prospectus documents were reviewed with respect to issues and responsibilities within federal jurisdiction. These include requirements under the:

- Fisheries Act;
- Navigable Waters Protection Act;
- Canadian Food and Drug Act;
- Canadian Wildlife Act;
- Migratory Birds Convention Act;
- Federal Pulp and Paper Effluent Regulations; and
- Canada-U.S. Boundary Waters Treaty.

The federal government agency comments as submitted by Environment Canada, comprise Appendix F.

Comments were also received from the U.S. Environmental Protection Agency, the U.S. National Park Service, the State of Washington Department of Ecology, the Colville Confederated Tribes and the Lake Roosevelt Forum. Environment Canada's report considers the comments and concerns forwarded by the U.S. contributors.

The federal reviewing agencies found that "there is no doubt that the proposal to replace the existing process with new pulping and bleaching technology together with biological treatment will reduce the discharge of many of the environmental contaminants, but there are still outstanding concerns to be addressed." The federal agency comments also state that:

- there is little discussion of the environmental impact of discharges/emissions from the expanded mill;

- mitigation proposals for air and water impacts need to be developed;

- data should be supplied to support a number of the claims made in the Prospectus documents; and

- a monitoring program will be required.

The conclusion reached by the federal agency review was that full public hearings were required.

At the request of the Honourable Bernard Valcourt, Minister of Fisheries and Oceans, the Honourable Robert de Cotret, Minister of Environment, agreed to establish an independent review panel, under the EARP and jointly with the provincial government, to review and conduct public hearings on the Celgar expansion project. The Department of Fisheries and Oceans is the EARP initiating agency with responsibility to ensure that all outstanding technical issues that fall under the jurisdiction of the Government of Canada are adequately addressed.

V. CONCLUSIONS AND RECOMMENDATIONS

V.1 A Stage II Report is Required

On the basis of comments received from the public and government agencies, the MPSC has required Celgar to submit a Stage II report, providing additional information regarding:

- impacts of emissions from the expanded mill on air quality;
- impacts of effluent discharges from the expanded mill on receiving waters;
- availability of surplus wood chips; and
- options for transporting additional wood chips to the mill.

The MPSC's decision to proceed directly to a Stage II report and bypass a Stage I report was based on the following considerations:

1. The Environmental Impact Assessment filed by Celgar was more detailed and comprehensive than would normally be expected in a Prospectus. While not clearly a Stage I report, it was more like a Stage I report than a Prospectus. The MPSC determined that little would be added to the project assessment by completing a Stage I report.
2. The public called for more participation in the review of this project. Stage II of the MPRP allows for maximum public participation in the review of the project.
3. The federal agency review resulted in a call for public hearings under the EARP. A joint federal-provincial review panel can be accommodated in Stage II of the MPRP.

V.2 An Independent Review Panel is Needed

Consistent with the MPRP and EARP Guidelines, and in response to public and key government agency comments, the MPSC has recommended the appointment of an independent review panel. The mandate of the panel is to conduct a public review of the environmental and associated socio-economic effects of the Celgar expansion project. In fulfilling its mandate, the panel will:

- conduct public hearings to be held in Castlegar and one or more neighboring communities;
- review the company's Stage II report and Prospectus documents and any other written material it deems relevant;
- provide for public access to all information provided to or prepared by it; and
- prepare a written report with recommendations to the provincial Minister of Environment, as well as the federal Ministers of Environment and Fisheries and Oceans. Recommendations shall be provided on the environmental acceptability of the proposed pulp mill expansion.

The panel will focus its review on the primary concerns noted in Chapter V. Terms of reference for the panel comprise Appendix B.

V.3 Construction Will Be Restricted Until the Review Is Complete

For a greenfields project being reviewed under the MPRP and/or EARP, no construction normally would be allowed to take place prior to Approval-in-Principle. However, the Celgar expansion project involves an expansion of an ongoing operation. As such, the MPSC has recommended that the federal and provincial governments adopt the principle that Celgar should be allowed to manage their existing operation in accordance with "good business management practices". This implies that the company should be allowed to complete work that has been previously authorized or that would be most efficiently undertaken during the annual maintenance shutdown.

V.4 Other Comments and Recommendations Regarding the Project

In addition to the core issues addressed in Sections V.1 and V.2, a number of other significant issues concerning the Celgar expansion project came to the attention of the MPSC.

The Committee's views on these issues are summarized below. Recommendations are also put forward for most of the issues. These recommendations are for the consideration of the independent review panel, company and/or permitting agencies, as appropriate.

1. **Monitoring and enforcement of environmental standards and public access to information regarding mill performance.**

   A large number of public submissions indicated concern about regulating agencies' ability and willingness to enforce environmental standards of the day. The MPSC is of the view that this concern can be partially addressed by providing for public access to emission and effluent discharge data, as requested in some submissions.

   IT IS RECOMMENDED THAT AN ENVIRONMENTAL IMPACT MONITORING AND REPORTING COMMITTEE BE ESTABLISHED TO OVERSEE THE DEVELOPMENT AND IMPLEMENTATION OF A PROGRAM TO MONITOR THE MILL'S EMISSIONS AND EFFLUENT DISCHARGES AND IMPACTS, AND TO REGULARLY MAKE THE RESULTS OF THE MONITORING PROGRAM PUBLICLY AVAILABLE. THIS COMMITTEE SHOULD BE CHAIRED BY THE REGIONAL WASTE MANAGER, BRITISH COLUMBIA MINISTRY OF ENVIRONMENT, AND SHOULD INCLUDE REPRESENTATIVES FROM THE CITY OF CASTLEGAR, THE CENTRAL KOOTENAY REGIONAL DISTRICT, THE COMPANY AND SUCH INTEREST GROUPS AS THE CORE GROUP DEEMS APPROPRIATE.

2. **Management of the fibre mat.**

   For its Stage II report, Celgar is required to identify the size, location and characteristics of the existing fibre mat in the river adjacent to the mill. This information is needed to assist government agencies to determine whether the material must be considered a Special Waste. However, it is the MPSC's view that it is inappropriate to instruct the company to remove the fibre mat before such time as it is determined whether this is the best and safest solution.

IT IS RECOMMENDED THAT THE COMPANY BE REQUIRED TO UNDERTAKE A RESEARCH PROGRAM TO IDENTIFY AND ASSESS THE FEASIBILITY OF OPTIONS FOR REMOVING OR MANAGING THE FIBRE MAT IN THE COLUMBIA RIVER ADJACENT TO THE MILL.

3. **Log storage on the river.**

At this time, the company has not indicated a requirement to increase log storage on the river. Should the company indicate a desire to increase log storage in the future, it is the MPSC's view that this activity should be subjected to adequate environmental impact assessment prior to receiving permitting agency approval.

IT IS RECOMMENDED THAT THE COMPANY BE REQUIRED TO EXPLORE ALTERNATIVES TO WATER-BASED STORAGE AND LOG HANDLING.

4. **Impacts of mill expansion on fish habitat.**

While it appears that the planned modernization should result in reduced impacts on fish habitat in the Lower Columbia River, little information regarding the current situation exists. However, without this baseline information, it will not be feasible to monitor the impacts of the Celgar expansion project, or that of other potential projects, on the river. Collecting this information could take up to three years and Celgar is not the only user of the river.

IT IS RECOMMENDED, IN KEEPING WITH THE REQUIREMENTS DEFINED IN THE LETTER OF CLARIFICATION FOR ITEM 2.5 OF THE TERMS OF REFERENCE FOR CELGAR'S STAGE II REPORT, THAT THE COMPANY BE REQUIRED TO PARTICIPATE IN A JOINT INDUSTRY/GOVERNMENT PROGRAM TO ESTABLISH BASELINE DATA FOR FISH HABITAT IN THE LOWER COLUMBIA RIVER, FOR USE IN IDENTIFICATION AND EVALUATION OF FUTURE IMPACTS ON SAID HABITAT.

5. **Discharge of dioxins and furans into the river.**

The use of chlorine in the pulp bleaching process results in the presence of a range of chlorinated organic (AOX) compounds in the effluent discharged from a pulp mill. Dioxins and furans are among the most toxic of AOXs typically associated with chlorine-using pulp mill operations.

A number of questions have been raised by the public and government agencies about the levels of AOX that will remain in the effluent discharged from Celgar's expanded mill. In the Terms of Reference for Celgar's Stage II report the company is required to report more specifically on the fate of the AOXs that are discharged to the river.

The formation of these compounds can be reduced by a number of methods, including reduction in the use of chlorine, oxygen delignification, extended pulp cooking and more complete secondary treatment of effluent. The company recently announced that it plans to "...conduct tests with peroxide use at various stages of bleaching to determine optimum usage results." The company indicated that its engineers "...are confident that research during the past year has produced enough reliable evidence that we can now integrate peroxide at this stage in the design process to reduce chlorine."

The company has also indicated that the equipment installed in the expanded operations would not be biased against the production of unbleached product.

IT IS RECOMMENDED THAT THE COMPANY BE REQUIRED TO REPORT THE RESULTS OF ITS EFFORTS TO INCORPORATE HYDROGEN PEROXIDE OR OTHER BLEACHING PROCESSES, AS THEY MAY BECOME KNOWN, TO THE ENVIRONMENTAL IMPACT MONITORING AND REPORTING COMMITTEE.

6. Archaeological Impacts.

The Ministry of Municipal Affairs, Recreation and Culture, requires the monitoring of the excavation for the effluent treatment area in order to determine the archaeological significance of the site.

IT IS RECOMMENDED THAT THE COMPANY BE REQUIRED TO RETAIN A QUALIFIED ARCHAEOLOGICAL CONSULTANT TO MONITOR THE EXCAVATION FOR THE EFFLUENT TREATMENT PLANT AND TO RECOVER AND ANALYZE ANY ARCHAEOLOGICAL REMAINS INADVERTENTLY EXPOSED BY

THESE EXCAVATIONS. THE MPSC REMINDS THE COMPANY THAT ANY CHANGES IN SITE PLAN, E.G. RESITING OF THE WORKCAMP, COULD RESULT IN A REQUIREMENT TO COMPLETE A PRELIMINARY ARCHAEOLOGICAL ASSESSMENT(S) IN THE EFFECTED AREA(S).

7. **Site beautification.**

The City of Castlegar has raised concerns about the view of the mill from public roadways and residential areas.

IT IS RECOMMENDED THAT THE COMPANY BE REQUIRED TO UNDERTAKE LANDSCAPING TO BEAUTIFY THE MILL SITE CONSISTENT WITH THE WISHES OF THE CITY OF CASTLEGAR.

8. **Impacts of the mill expansion on social services.**

Peak employment during the construction phase of the Celgar expansion project is estimated at 1,400. The sudden influx of this number of workers into one small community can have a disruptive effect on social services. The City of Castlegar has requested assistance in determining the extent to which existing services might be affected, and in monitoring the impact of the expansion on an on-going basis. The Ministry of Municipal Affairs, Recreation and Culture has recommended that the company be required to prepare a socio-economic impact assessment in order to define current and projected levels of service required in the community under two scenarios: with and without the expansion project.

The Ministry has indicated the socio-economic impact assessment can be undertaken subsequent to Approval-in-Principle, and therefore, recommends that this requirement be attached as a condition of the Approval-in-Principle.

Celgar, however, has voluntarily undertaken to complete a comprehensive socio-economic impact assessment to be filed with the Stage II report. The Terms of Reference for the assessment, developed independently by Celgar and the company's consultant, are included in Appendix G.

IT IS RECOMMENDED THAT A SOCIAL SERVICES IMPACT COMMITTEE BE ESTABLISHED FOR THE PURPOSE OF MONITORING THE IMPACTS OF THE CONSTRUCTION MANPOWER INFLUX ON LOCAL SOCIAL SERVICES AND HOUSING. REPRESENTATIVES FROM THE CITY OF CASTLEGAR (CHAIR), THE CENTRAL KOOTENAY REGIONAL DISTRICT, THE MINISTRY OF SOCIAL SERVICES AND HOUSING; AND THE COMPANY SHOULD SIT ON THE COMMITTEE. IT IS FURTHER RECOMMENDED THAT AS THE CELGAR EXPANSION PROJECT'S CONSTRUCTION PERIOD PASSES ITS PEAK AND MAJOR PROJECTS SPONSORED BY B.C. HYDRO START-UP, CELGAR'S POSITION ON THE COMMITTEE BE REPLACED BY B.C. HYDRO.

IT IS RECOMMENDED TO THE COMPANY THAT IT COORDINATE ITS PLAN FOR HOUSING CONSTRUCTION CREWS WITH B.C. HYDRO (WHICH IS EXPECTED TO UNDERTAKE MAJOR CAPITAL WORKS IN THE CASTLEGAR AREA IN THE MID TO LATE 1990'S). IT IS ALSO RECOMMENDED TO THE COMPANY THAT IT INSTRUCT ITS CONTRACTORS TO HIRE LOCAL LABOUR AND PURCHASE LOCAL SUPPLIES WHENEVER POSSIBLE.

9. **Electrical load displacement and energy conservation.**

The Ministry of Energy, Mines and Petroleum Resources has requested the company to forecast the expanded mill's electricity generation and consumption, and to further explore opportunities for power conservation and on-site power generation. A significant increase in on-site power generation capacity (beyond 20Mws) will necessitate the company obtaining an Energy Project Certificate.

IT IS RECOMMENDED THAT THE COMPANY BE REQUIRED TO SUBMIT THE REQUESTED INFORMATION TO THE MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES AND OBTAIN AN ENERGY PROJECT CERTIFICATE, IF NECESSARY.

10. **Greenhouse gas emissions and global warming.**

Concerns about global warming caused by "greenhouse gases" such as carbon dioxide (CO2), methane, nitrous oxide (NOX) and volatile organic compounds (VOC) are pervasive.

In the Terms of Reference for the Stage II report, the company is required to develop baseline information regarding the current levels of NOX, VOC and sulphur emissions and to model project emissions from the expanded mill. The company is also required to address the impact and management of sulphur emissions in the Stage II report. However, standards for NOX, VOC and CO2 emissions do not currently exist, and therefore, the company has not been asked to specifically address the impact and management of these emissions.

The Government of British Columbia is currently participating with the federal government and other provinces in the development of a national strategy for the control of NOX and VOC emissions. When the strategy is developed, standards will be adopted and applied. In the meantime, the British Columbia Ministry of Environment does not anticipate approving NOX emissions for 1994 which will cause current regional levels to be exceeded.

A national or provincial strategy for dealing with CO2 appears to be further down the road than for NOX and VOC. In the meantime, the British Columbia Ministry of Environment will encourage maximum efficiency of operation.

11. **Use of recycled fibre.**

At this time it does not appear possible for the Celgar pulp mill to include recycled paper in its production process to any significant degree. The Celgar pulp mill produces kraft pulp. The product is essentially a pure fibrous mixture of cellulose which is used in a wide range of products (not only paper) because of its strength and purity. Usually kraft pulp is added to recycled fibre to produce a paper product with the strength and durability that is required. Recycled fibre is best utilized in the making of paper which Celgar does not produce.

V.5 Comments and Recommendations Regarding the Review Process

A number of concerns regarding the review process for the Celgar expansion project also came to the attention of the MPSC. The concerns are addressed below.

1. **Public participation in the review process.**

In their report to the City of Castlegar, the Celgar Expansion Advisory Group said:

> "The Major Project Review Process should have been explained fully to the public in October when it was decided that Celgar's expansion would go through the process. This could have been done through media or informational meetings. Since Celgar is the first project to be handled under the process, the public is not sure how to participate. For the people trying to put forward responsible input, the information is unavailable or difficult to obtain. All reports should have been widely distributed and then informational sessions held where people could receive further clarification. With proper information the input from the public may be more positive and result in faster Approval-in-Principle."

The MPSC agrees. Unfortunately, the timing of the Celgar project and the finalization of the MPRP Guidelines precluded early community-based information sessions.

For future projects MPSC-sponsored information meetings will be held shortly after public release of the Prospectus. These meetings will focus on how the MPRP operates and on how the public can participate in the review process.

2. **Management of Crown forests and Pulpwood Agreement #9.**

Just under half of the public submissions received during the review period indicated concern over the impact of the project on timber harvesting practices and the disposition of Pulpwood Agreement #9.

Celgar does not currently possess rights to harvest timber on Crown forest land, and purchases its wood fibre requirements from manufacturing operations which have surplus wood fibre supply. The company has stated that all of its wood fibre requirements for the expanded mill operation can be met through access to by-product chips from area sawmills and from pulp logs produced as a by-product of the area's sawlog harvest. Therefore, the mill expansion proposal is not contingent upon the company securing new sources of fibre supply requiring new timber harvesting agreements.

The company has, however, applied for Pulpwood Agreement #9, which could be utilized to access timber that is not included in the currently allocated timber supply, in the event of a shortfall in surplus wood fibre supply. There is competition for this pulpwood agreement. The disposition of PA #9 will be subjected to a separate public hearing by the Ministry of Forests pursuant to Section 34 of the Forest Act. As a result, the impact of the project on the management of provincial Crown forests has not been included in the Terms of Reference for the federal/provincial panel.

3. C.P. Rail's application to abandon the Boundary Subdivision.

Over half of the submissions received by the MPSC indicated concern about the increase in chip truck traffic that would result from the mill expansion, and encouraged the consideration of other transportation options. An analysis of chip transportation options is required in the Stage II report.

Twenty-five public submissions also recommended that the MPSC intervene, or require Celgar to intervene, in C.P. Rail's application to abandon the Boundary Subdivision, to ensure that the rail alternative to truck transport is maintained in the region.

The Government of British Columbia, through the Ministries of Regional and Economic Development; and Transportation and Highways, filed interventions with the National Transportation Authority (NTA) on March 21, 1990. According to NTA guidelines, a decision on the application for abandonment shall be made on or before September 22, 1990. There is provision in the NTA guidelines for public hearings, but it is not yet known whether hearings will take place.

4. **Requests for intervener funding.**

It is not Government of British Columbia policy to make funding available to interveners in reviews of major projects. However, independent review panels have the authority to hire technical or other specialists to provide advice and clarify issues. These specialists may be made available to interveners, upon request, to ensure access to technical expertise and better dissemination of information to the public.

APPENDIX A

Information Requirements for Stage II Report

TERMS OF REFERENCE FOR THE STAGE II REPORT

The proponent is required to meet the detailed information requirements with regard to **air and water impacts** included in **Appendix A**. In addition to these environmental issues, the Stage II report Terms of Reference require the proponent to address the information requirements identified below.

Fibre Sourcing and Transportation Impacts

1.0 Fibre Sourcing

1.1 The proponent is required to prepare a residual chip supply analysis indicating:

- the current supply and disposition of residual chips produced;
- the current supply utilized by Celgar Pulp and other users.

1.2 The proponent is required to indicate the amount of pulp fibre in log form which will be utilized by the proposed Celgar mill and the potential sources of that supply.

1.3 Plant infrastructure requirements associated with each alternative source of fibre should be discussed.

1.4 The proponent is advised to outline the regional economic impact of increasing demand for pulp quality wood fibre.

2.0 Transportation Options and Impacts

2.1 The proponent is required to prepare an analysis of current and projected truck and rail traffic in the region, by cargo, origin, destination and routing.

2.2 The proponent is required to prepare a detailed feasibility analysis evaluating the alternative transport options for woodchips (rail, road and water).

Volume assumptions and infrastructure requirements should be assessed and evaluated for each option.

2.3 The proponent is required, in consultation with the B.C. Ministry of Transportation and Highways, to undertake information sharing and analysis of the highway system's ability to accomodate projected truck volumes, configurations and weights, in terms of traffic safety, pavement conditions and ferry capacity.

Province of
British Columbia

Ministry of
Regional and
Economic Development

712 Yates Street
Victoria
British Columbia
V8V 1X5

File Copy/Day Copy

July 9, 1990

Mr. Wilf Sweeney
Celgar Expansion Project Manager
Celgar Pulp Company
c/o H.A. Simons Ltd.
7th floor, 570 Dunsmuir Street
Vancouver, British Columbia
V6B 1Y1

Re: Clarification of the Transportation Terms of Reference for Celgar's Stage II Report

Dear Mr. Sweeney:

This letter is to clarify the information requirements for the transportation portion (Items 2.1, 2.2 and 2.3) of the MPRP terms of reference for Celgar's Stage II Report. This clarification is based on our understanding of the discussions that took place on May 15, 1990, at a meeting which was attended by representatives of Celgar Pulp Company (the company), the British Columbia Ministries of Transportation and Highways (MOTH) and Regional and Economic Development (MRED), and by your company's consultant and counsel.

We agreed that the transportation portion of your study should:

1. **Outline the options open to Celgar for transporting chips to the mill:**
   - focusing on transport options (road, water, rail) that are currently available, currently planned or feasible for development within the next two years;
   - noting deficiencies, where appropriate; and,
   - noting alternate routes as appropriate.

.../2

2. **Estimate the costs of each transportation option:**
   - on the basis of operating costs that will be incurred by Celgar; and,
   - including amortized costs of any infrastructure requirements (docks, loading facilities, etc.) that are associated with each option.
3. **Compare the environmental, economic and social impacts of the various transportation options:**
   - including consideration of the environmental (noise, air quality) and socio-economic impacts of expansion-related increases in traffic;
   - focusing on the impacts of net new traffic (or incremental impacts) due to the mill expansion, where possible; and,
   - generally identifying potential impacts on social services, particularly regarding resulting changes in the demand for fire and ambulance services in the region.
4. **Select the most likely transportation scenario on the basis of cost to the company.**
5. **Provide engineering estimates of the physical, safety and related impacts of net new traffic on principal areas of concern for the selected option:**
   - basing the analysis on existing information regarding the physical condition of the roads, to be provided by MOTH;
   - including an engineering assessment of the likely physical and safety impacts in sufficient detail to enable MOTH to develop order of magnitude costs;
   - generally discussing highway conditions and requirements for upgrading, as appropriate; and,

.../3

- generally discussing capacity limitations (for example, with regard to the ferry service) and their importance in the selection of the most likely scenario.

Principal areas of concern, as identified by Mr. Gordon Sutherland, Regional Director, Kootenays Regional Office (MOTH) and Mr. Don Barcham, Regional Manager Planning, MOTH, include:

- Highway 23/6/3a, Revelstoke to Castlegar;
- the Castlegar interchange;
- Highways 33 and 6 (Monashee route) if any material increase in traffic is proposed; and,
- other roads passing through communities where any material increase in traffic is proposed (specifically Creston, Greenwood and Grand Forks).

At this time, Highways 1 and 97 have not been identified as specific areas of concern, except where they transit the aforementioned communities. Celgar Pulp Company may identify other areas of concern on the basis of the extent to which net new traffic is proposed. The addition of areas will depend, of course, on the company's own chip sourcing plan.

The Ministry of Transportation and Highways has offered to make existing baseline data available to your company's consultants, as well as information regarding the ferry schedule.

We trust this clarification meets your requirements. We look forward to reviewing your report.

Yours sincerely,

Derek Giffin

for
Frank Blasetti
Co-chairman
Major Project
Steering Committee

David Parsons

for:
Doug Dryden
Co-chairman
Major Project
Steering Committee

cc: Mr. Gordon Sutherland

Appendix A

Detailed Stage II Information Requirements

The following information requirements have been developed jointly between the B. C. Ministry of Environment and the federal environmental agencies to focus Celgar's efforts in completing Stage II.

1.0 Effluent

1.1 The proponent must explain why some chlorine bleaching is still required and why alternatives such as hydrogen peroxide cannot be substituted at this time. If hydrogen peroxide substitution is not feasible now, the proponent should indicate how mill design will accommodate addition of this technology at a later date.

1.2 The report should deal more specifically with the fate of chlorinated organics (AOX) generated at the mill. The following questions need to be addressed:

- a) How much AOX will remain with the primary solids?
- b) How much AOX will remain with the secondary solids?
- c) How much AOX will pass through the effluent treatment system?
- d) What species of AOX are likely to be separated at the various stages of treatment?
- e) Does the 1.5 kg AOX/t limit represent the most persistent forms of AOX and are these the most toxic or the most likely to accumulate in the food chain?

More information is required on AOX including concentrations and volumes in solid waste, surface water, groundwater, sediments and biota. Existing data collected in the Columbia River should be evaluated to identify possible environmental impacts.

1.3 Chlorinated organics associated with biosolids in the mill effluent will be available for biological uptake. The mill design should ensure that biosolids are reduced to as low a concentration as possible, even if flocculation or extended treatment is required.

The proponent has used current Provincial Level A objectives for determining loadings of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) in mill effluent. The Level A concentrations are less stringent than can be achieved using the proposed technology and the proponent should not assume that permit limits will be based on Level A objectives. Instead, the assessment of BOD and TSS concentrations should be based on levels that can be realistically achieved with the technology proposed. The new federal regulations for these variables will be lower than the provincial objectives.

1.4 The proponent should confirm that the proposed extended aeration activated sludge system is capable of removing acute toxicity (ie.passing the 100% 96 hr LC50 test) prior to dilution with cooling water at the foam tank. The design and location of sampling equipment will be critical to obtaining a true flow proportional sample of effluent. Sampling procedures (eg.grab or composite samples) will be addressed as part of the permitting system.

1.5 The individual resin acid concentrations after treatment should be predicted using data from other mills. The proponent should substantiate claims made in the report for a reduction from 216 kg/d to 20 kg/d in resin acids through treatment.

1.6 The proponent should substantiate estimates of changes to effluent colour with the expansion. Based on the effluent concentration predicted, a slight exceedence of the CCME guideline of 15 TCU is anticipated between the point of discharge and the complete mix area during low flow periods.

1.7 The efficiency and effectiveness of the proposed effluent treatment system, including deep tank injection and activated sludge, must be documented. Reasons for selecting the proposed treatment system should be provided, as well as examples of where it has been used.

1.8 Celgar should update the existing mill effluent characteristics listed on Table 5.7 and 5.9 of the Prospectus. If current effluent data are not available, the proponent should collect a minimum of 6 samples for the analysis for those variables listed in Tables 5.7 and 5.9.

2.0 Receiving Water

2.1 Existing organic solids of pulp mill and log handling origin on the river bottom represent a problem that needs to be resolved. Fibre losses related to pulpmill effluent discharges are likely a major source of chlorinated organics entering the food chain.

With regard to the fibre mat, the following issues must be addressed by Celgar regardless of whether expansion proceeds:

a) The surface area and depth of contamination in the vicinity of the mill must be better defined.

b) The characteristics of the fibre mat must be determined with respect to chlorinated organic content to determine if the material must be considered as a Special Waste.

c) Alternatives to water storage and handling of logs should be documented that will avoid log handling residue buildups.

Celgar must commit to a process to evaluate the feasibility of removal or management of these solids as part of Stage II.

2.2 The terms of reference given to the proponent by the Ministry of Environment required the prospectus to evaluate impact scenarios with proposed B.C. Hydro Dam construction and modification. This has not been done. The Ministry appreciates Celgar's position that they do not have enough information to do this evaluation. However, we strongly recommend that Celgar continue discussions with B.C. Hydro to determine to what extent Hydro's plans (particularly with respect to the Keenleyside and Murphy Creek projects) may alter the flow regime of the Columbia and therefore affect the dispersion and dilution of Celgar's effluent discharge and impacts on water quality under various flow conditions. The hydraulics of the Columbia River from the Keenleyside Dam to its confluence with the Kootenay River, especially the formation and breakdown of the "hydraulic dam", should be understood and the distance required for complete mixing under various flow conditions should be provided and fully supported.

2.3 The potential for increased algal growth in the river due to nutrient increases in the effluent through mill expansion needs to be more adequately addressed. B. C. Ministry of Environment information indicates that under certain flow/temperature conditions there are significant growths of algae and fungus that may be impacting fish habitat downstream of the mill. Also, due to the large input of phosphorous from Cominco at Trail, the Columbia River at Waneta maybe nitrogen limited. The proponent should reassess effluent nutrient loadings and provide supporting documentation for the earlier estimates of nitrogen and phosphorous levels at the international boundary.

There are data available on nitrogen and phosphorous in the Columbia River through the Canada/B.C. Water Quality

Monitoring Agreement. Celgar should interpret nitrogen to phosphorous ratios for stations at Birchbank and Waneta, and if as a result of this interpretation, there is a strong indication of nitrogen limitation in the lower Columbia, nitrogen to phosphorous ratios should be analyzed for algal tissue to aid prediction of nutrient-related impacts of mill expansion.

Since biosolids discharged to the river from the treatment process provide a source of algal nutrients, flocculation of the waste stream prior to final clarification may assist in reducing overall effluent nutrient levels.

2.4 The proponent should predict the impact of the expansion on water quality, biota and sediments at the international border and at other specific locations as indicated by Environment Canada in a January 30, 1990, letter (Churchland to Crozier).

This monitoring should entail measurement of chlorinated organic compounds (chlorinated phenols, resin acids, fatty acids, guaiacols, catechols, dioxins, furans and AOX) in the effluent and extrapolation to the international boundary based solely on dilution. The impact of assimilation or sedimentation should be determined by actual measurements of Columbia River water coinciding with effluent measurements.

In addition, since most of the hydrophobic toxic organic compounds are expected to be associated with biosolids from mill effluent, Celgar should also predict biosolids concentrations at the border and interpret effects of predicted concentrations.

The Prospectus referred frequently to ambient quality objectives in the Pollution Control Objectives for the Forest Products Industries of British Columbia. These objectives are outdated. Instead, the Ministry's Water Quality Criteria documents and CCME guidelines should be used (as was done for nitrogen and algal productivity). At the international boundary, predicted water quality conditions should be compared with Washington State Water Quality Standards for the Columbia River (Water Quality Standards for Surface Waters of the State of Washington, 1988).

2.5 The proponent should provide a current assessment of the fisheries resource using recent data and information available from all agencies involved with fisheries studies in the Lower Columbia River Basin (BC Hydro and MOE). The assessment should incorporate all current scientific research (ie John Carey's La tuque study) regarding impacts of bleached kraft pulpmill effluents. Also, the physical impacts of mill construction on fisheries habitat should be assessed. The proponent should provide an outline of the intensive multi-year fisheries study planned by BC Hydro, which is designed to better define fish spawning, rearing, feeding and migration patterns in the Lower Columbia River. The proponent should also provide the design of, and a commitment to participate in, an intensive, integrated monitoring program which will define the current status of the ecosystem including water chemistry, periphyton (algae) and benthic insects. In the event that the B. C. Hydro studies referenced above do not proceed by fall 1990, it is the responsibility of the proponent to undertake and fund appropriate fisheries studies approved through the MPRP.

2.6.1 Celgar is required to update data gaps identified in Section 8 of the Propectus by interpreting receiving environmental data recently obtained by the proponent and obtaining and interpreting current receiving environmental data gathered by government and B. C. Hydro for dioxins, furans, chlorophenols, chlorocatecols, chloroguaiacols, resin and fatty acids listed below:

Dioxins and Furans

Total T4CDD
Total P5CDD
Total H6CDD
Total H7CDD
Total O8CDD
Total T4CDF
Total P5CDF
Total H6DCF
Total H7CDF
Total O8CDF

Chlorophenols, Catecols and Guaiacols

TeCG
TeCC
PCP
Total TCP
Total TCC
Total CV
Total DCP
Total DCG
Total DCC
Total TCG
Total TeCP
Total CA

Resin and Fatty Acids

Pimaric
Abietic
Sandaracopimaric
Neoabietic
Oleic
Linolenic
Dehydroabietic
Levopimaric
Isopimaric
Palustric
Linoleic

2.6.2 Celgar should conduct a short term receiving water quality monitoring program consisting of a minimum of 6 samples collected over a 3-4 week period and incorporating this information into the Stage II report. Specifically, samples should be taken upsteam of the mill (Provincial Site 0200183) and downstream of the mill (Provincial Site 0200200) for the following parameters: calcium, magnesium, sodium, chloride, sulphate, colour (TAC and single wavelength [965 nm], pH, conductivity, temperature, non filterable residue(NFR), filterable residue (FR), turbidity, ammonia, nitrate & nitrite, total phosphorous, total dissolved phosphorous, orthophosphate, and total Kjeldahl nitrogen.

2.7 The impacts of the proposed changes to the foreshore should be assessed.

2.8 Groundwater/surface water relationships for the landfill site, chemical handling facilities, hog fuel and chip area, and biotreatment ponds must be understood to ensure that there will be no leaching from these facilities which will impact the Columbia River. At Stage II, Celgar should provide: (a) An analysis of existing groundwater data; (b) An outline of a groundwater study to supplement these data and (c) identify downstream groundwater users. Such a study should address local groundwater flow directions and flow rates, contaminant concentrations, flow direction and flow rates and landfilling practices. Measurement parameters should include AOX and resin acids and other effluents expected to discharge from the landfill; and (d) a schedule for carrying out the study. Celgar must also commit to reasonable remedial measures as indicated by the groundwater sampling program (For example,the option of collecting and piping the landfill leachates and leachates from chips and hog fuel to the biotreatment ponds should be reviewed).

3.0 Air Contaminant Emissions

3.1 The proponent should estimate emission rates from the plant based on the plant production rate expressed as a consistent unit. Further, the emissions of contaminants should be provided separately for both the maximum design case and the average plant production.

In the current prospectus, the new mill capacity has been given as: "average of 1200 ADT/d of bleached marked grade kraft pulp" (p. 10), as "operating capacity to 1398 ADUT" (p. 45), and "at rated capacity" (Table 3.9, p. 47). This raises some uncertainty regarding the comparability of emission estimates provided in various sections of the report.

3.2 The proponent should set out the assumptions used to estimate the maximum emission rate of each contaminant. Specifically, it should be confirmed that emission rates are maximum 1-hr values. In addition the proponent should provide the sulphur composition of HVLC, LVHC and the clarifier sludge along with the input rates to the boiler.

More detail of the NOX emission rate estimates from the boiler will be necessary. To determine the potential atmospheric impact from increased NOX emissions, the proponent should estimate current NOX and volatile organic compounds (VOC) (for both anthropogenic and biogenic) levels from available emission data (and from emission factors where necessary) and predict the subsequent production of ozone. This calculation should be repeated for predicted NOX and VOC levels due to the mill expansion.

3.3 The proponent should verify the efficiencies of the various emission control devices listed on p. 42-43 as has been done for the recovery boiler electrostatic precipitator.

3.4 Celgar proposes to use the #2 Power Boiler to burn HVLC gases and clarifier sludge as a routine, as well as to burn LVHC gases when these can not be burned in the lime kiln. However, the AP-42 emission factors used in the report are for bark and wood burning only. The proponent should clarify whether this additional sulphur input to the boiler has been taken into account to estimate the SO_2 emission rate. If not, then revised SO_2 emission rates should be presented.

CIRRUS consultant's extrapolation of the Prince George test burn of penta-chlorophenol contaminated woodwaste to the burning of secondary effluent treatment sludge in the present proposal is not adequate for the Ministry of Environment to approve the incineration proposal. The Ministry of Environment will require an expert review of this proposal because of the burning of chlorinated organics in #2 Power Boiler, and the concentration of chlorinated organics in the sludge. We suggest that Environment Canada be contacted to determine if a literature review has been done. The proponent must research this issue as extensively as possible to determine if other mills burning sludge have been evaluated for chlorinated organic combustion products.

3.5 The proponent should confirm whether the impact of burning LVHC gases in the lime kiln has been considered in the prospectus. It is essential to know how much SO_2 removal occurs in the kiln so that the stack emission rate can be verified. The proponent should clarify the statement on p. 45, "SO_2 emission rates will be controlled predominantly by the combustion process in the kiln". The combustion process itself does not control SO_2, rather it is produced during combustion. Any SO_2 removed in the kiln results from the reaction between the lime produced in the kiln and the SO_2 in the kiln gas.

3.6 Because of predicted level A excursion of ambient SO_2 concentrations and the availability of equipment to scrub this gas, the proponent should address the advantages and disadvantages of providing this treatment or alternatives to reduce emissions from the recovery boiler. Control of SO2 and NOX at source will reduce the potential for acid precipitation.

3.7 The proponent should provide an assessment of what interim or short-term management actions can be taken at the mill to further reduce TRS and SO_2 emissions in the event air quality for these parameters deteriorates due to meteorological conditions.

3.8 The proponent should provide information on the advantages and disadvantages of utilizing cooling towers as an alternative to the proposed spray effluent cooling system. The Ministry has concerns with possible TRS emission and fog formation from a spray effluent cooling system.

4.0 Air Quality

4.1 The proponent needs to address the following issues with respect to dispersion modelling and impact assessment:

a) The dispersion model needs to be rerun to determine the change in areal distribution of the principal pollutants (TRS, SO2, NOX, and particulates) emitted from the existing and expanded mill and the consequent changes in air quality in the vicinity of the mill.

b) Maps showing isopleths of maximum concentrations of pollutants for the various averaging periods for the existing and expanded mill should be completed.

c) The meteorological data that were missing (September-December) need to be added to complete one year of record. The one year of meteorological data should be analyzed to determine how representative they are of the long-term conditions by comparison with the long-term records at the airport station.

d) The estimated short-term and long-term frequencies of exceedances of Level A and Level B ambient air objectives at all receptors where exceedances are predicted should be provided by the proponent for the existing and expanded mill scenarios for each pollutant.

e) The proponent should confirm that maximum emission rates expected for normal operations (described as the 99th percentile rate) were used in the model. The Terms of Reference required that these rates be used and any variation in emission rates and other emission characteristic should be specified.

4.2 The following comments are based on the computer input-output files associated with the air quality modelling that were obtained directly from CIRRUS for review and verification:

a) The emission sources and rates should be verified and confirmed as the design values for this mill; the TRS source identified as "SOAP" in the input file was not included in Tables 3.7 and 3.8 of the report but was included as a TRS emission source in the modelling evaluation.

b) There was a source labelled "Others" in the input files. It should be confirmed as to whether they are real sources with design emission rates or just imaginary sources representing the difference between the design emission rate and that allowed for a "Level A" mill. Only real sources are to be modelled and evaluated.

c) The distribution of the receptor points (as indicated on the plot of receptors that was provided directly from CIRRUS) shows a deficiency of receptors in the areas to the northwest, north, northeast and east of the plant site on the land immediately across the Columbia River on the lower slopes. This deficiency and wide gap where there were no receptor points did not allow the determination of the maximum and the total areal impacts of the mill in the whole modelling domain and missed the impact of the mill emission on the inhabited areas located therein. Due to the proximity of this area to the plant site, the impact of the mill on air quality is expected to be more significant than on the six other, arbitrarily selected sites. Receptor points of adequate density should be situated in these areas. Also, adequate identification codes of all receptor points should be provided.

4.3 A shortcoming of the model is that it does not deal with complicated situations such as fumigation events or the "plug flow" scenario which are known to occur in the valley. (ie. where pollutants accumulate in the valley at stack height and then overturn all at once due to ground warming, or when light winds blow pollutants up the Arrow Lake valley in the morning and back down toward Castlegar in the afternoon). These factors will probably cause higher concentrations than predicted in a temporal pattern similar to what is observed now. The proponent should explain the effect of these events on TRS concentrations in the area. Similarly, the additive or potential synergistic impact with pollutants (ie SO_2 and particulates) from other emission sources in the valley have not been considered.

4.4 The effluent treatment system (pond) has been identified as a major emission source and should have been treated as an "area" emission source. In the present modelling and evaluation, this source was not included in the RTDM model evaluation due to a model limitation. It was considered as a "point" source, in the MPTER modelling. The existence of the effluent treatment system should be dealt with using a more appropriate dispersion model such as the Industrial Source Complex (ISC) Model as suggested in the MOE Terms of Reference.

The proponent should substantiate the decision to use the emission rate of 2.778 g/s TRS from the effluent pond and/or document the use of another rate if more appropriate.

4.5 The proponent should address the impacts of SO4 (from the oxidation of SO2), particulate matter and water vapour on visibility.
Specifically:

a) The particle size of emissions from electrostatic precipitators and the fate of these particles must be provided. Evaluation of ambient PM_{10} must be addressed. The anticipated PM_{10} criteria is likely to be in the range of 75-100 ug/m3.

b) The scattering from sulphate particles from SO_2 oxidation should be included in the evaluation since this source may degrade visibility.

4.6 The environmental impact of SO2 and NOx emissions should be assessed. Since this is a complex and difficult calculation with a great deal of uncertainty, Celgar should determine how best to proceed based on discussions with Ministry of Environment staff and federal Atmospheric Environment staff. The first step should be to do an order of magnitude calculation of impacts using a worst case scenario based on loadings to the environment as deposition. The impacts of the emissions on vegetation and soils should be assessed. Any changes anticipated in the corrosiveness of the emissions should also be outlined.

4.7 The terms of reference and comments provided above with respect to air quality are intended to supplement and reinforce the original terms of reference for the air quality impact evaluation and do not supersede the original terms as agreed and provided to Cirrus Consultants by R. Crozier of the Ministry of Environment on August 21, 1989.

5.0 SOLID WASTE

Celgar needs to address the potential for AOX leaching from landfill waste by listing specific waste materials, and describing the AOX content and leachability of waste material, including ash and flyash, entering the land fill. Celgar should present references from other areas describing waste characteristics if these are not available locally. Information on land fill wastes together with the groundwater evaluation (item 2.8) will determine what additional remedial options, if any, may be required to control leachates and resulting groundwater contamination.

6.0 STORM WATER COLLECTION

A storm water collection system that will facilitate capture of any spill or contaminated runoff in the mill yard area should be adequately described in the mill design specifications.

Province of
British Columbia

Ministry of
Regional and
Economic Development

Victoria
British Columbia
V8V 1X5

File Copy/Day Copy

July 9, 1990

Mr. Wilf Sweeney
Celgar Expansion Project Manager
Celgar Pulp Company
c/o H.A. Simons Ltd.
7th floor, 570 Dunsmuir Street
Vancouver, British Columbia
V6B 1Y1

Re: Clarification of the Fish Habitat Study Terms of Reference for Celgar's Stage II Report

Dear Mr. Sweeney:

This letter is to clarify Item 2.5 in the detailed information requirements for Celgar's Stage II report, as it appears in Appendix A of the Executive Summary of the Prospectus Stage Report of the Major Project Steering Committee. This clarification is based on our understanding of agreements that were made at the meeting on May 16, 1990, which was attended by representatives of the British Columbia Ministries of Regional and Economic Development and Environment, Environment Canada, Celgar Pulp Company (the company), B.C. Hydro and other users of the lower Columbia River.

The Stage II report should:

- incorporate fish tissue bioaccumulation data from current Celgar studies;
- incorporate all data from Environment Canada and the British Columbia Ministry of Environment that was made available to you as of May 29, 1990; and,
- reference current scientific literature regarding impacts of chlorinated organics accumulation.

Current literature concerning dehalogenation of chlorinated organics should also be reviewed, and findings relevant to existing deposits on the river bottom should be documented.

Item 2.5 in the detailed information requirements instructs you to reference the "B.C. Hydro Study" for fish habitat data. As this study is not yet underway, you are not required to submit fisheries study results other than those described above in Celgar's Stage II submission. You are required, however, to ensure that existing river and fish habitat conditions are documented prior to start-up of the proposed expanded mill.

To this end, Celgar is required to indicate, in writing, the company's commitment to participate in a joint government/industry integrated environmental assessment. This assessment should be designed to comprehensively describe the current status of the Columbia River ecosystem from Keenleyside Dam to the International Boundary. Expanded from the original terms of reference, the assessment should include a study to describe fish spawning, rearing, feeding, migration patterns and angler use of the resource.

A monitoring program design for this assessment is currently being prepared by Sigma Engineering Ltd. A synopsis of integrated environmental assessment design including fish habitat study should be included in Celgar's Stage II submission. The complete assessment design should be included as an appendix to the Stage II submission. Depending on the recommendations of the Celgar Expansion Review Panel, further work concerning receiving water monitoring may be required.

In the unlikely event that agreement cannot be reached between the various parties regarding design, terms of reference for and funding of an integrated environmental assessment program for the lower Columbia River, Celgar will be required to independently carry out a program modified to deal specifically with the impacts of the proposed expansion.

We trust this letter provides the clarification you need to proceed with preparation of this portion of the Stage II Report.

Yours sincerely,

Chuck Griffin

for Frank Blasetti
Co-chairman
Major Project
Steering Committee

David Parsons

for Doug Dryden
Co-chairman
Major Project
Steering Committee

cc: Dennis McDonald

APPENDIX B

Independent Review Panel Terms of Reference

Canada British Columbia

News Release/Communiqué

FEDERAL ENVIRONMENTAL ASSESSMENT
REVIEW OFFICE

B.C. MINISTRY OF ENVIRONMENT

June 28, 1990

1990:43

MINISTERS NAME PANEL TO REVIEW CELGAR PULP MILL EXPANSION

VICTORIA -- The federal and provincial governments have appointed a panel to conduct an independent review of the environmental and social effects of the Celgar Pulp Mill expansion proposal for Castlegar, B.C.

Establishment of the review panel is in response to concerns expressed by residents of the area, as well as to meet the requirements of federal and provincial environmental agencies.

Federal Environment Minister Robert R. de Cotret and B.C.'s Environment Minister John Reynolds today announced the names of the panel members and released the Terms of Reference.

Jill Bodkin, former B.C. Deputy Minister of Consumer and Corporate Affairs, has been named Chairperson. The other two panel members are University of British Columbia ecology professor Dr. Thomas Northcote and forest industry consultant Dr. Paul R. Thomas.

The Panel has been asked to focus its review on ambient air quality, water quality including impacts on fish and fish habitat, and the impact of additional truck traffic resulting from the transportation of additional wood chips to the mill.

.../2

Recycled Paper

If, at the completion of the review, the Panel concludes that the proposal is acceptable, it will explain the basis for that conclusion and recommend terms and conditions under which the pulp mill expansion could proceed. If the panel concludes that the proposal is unacceptable, it will similarly explain the basis for its conclusion.

De Cotret said, "My colleague, the Honourable Bernard Valcourt, Minister of Fisheries and Oceans, recognizing that uncertainty exists with regard to the impacts of the project and that there is public concern, has asked me to work with the Province in convening a panel."

Reynolds said, "This review will ensure that all questions of potential environmental impact are satisfactorily addressed before any decision is made on the Celgar proposal."

The review has been established under the British Columbia Environment Management Act and is being managed under the B.C. Major Project Review Process. The review is also in accordance with the requirements of the federal Environmental Assessment and Review Process (EARP). Fisheries and Oceans Canada will serve as the initiating department in keeping with its responsibilities under the federal Fisheries Act.

-30-

Attachments: Terms of Reference for the review panel and biographies of the panel members.

FOR FURTHER INFORMATION CONTACT:

Doug Dryden
Policy and Planning Division
Ministry of Environment
Victoria, B.C.
(604)387-9669

Colin Lachance
Federal Environmental Assessment
Review Office
Suite 510 - 750 Cambie Street
Vancouver, B.C.
(604)666-2431

CELGAR PULP PROJECT

REVIEW PANEL TERMS OF REFERENCE

BACKGROUND

Celgar Pulp Company is proposing to expand its bleached kraft pulp mill on the Columbia River, at Castlegar, British Columbia. The company operates as a joint venture between CITIC B.C. Inc. and Power Consolidated (China) Pulp Inc.

The Celgar project is currently subject to British Columbia's Major Project Review Process (MPRP)). Celgar filed an Environmental Impact Assessment report as a Prospectus with the Major Project Steering Committee (MPSC) in December 1989; a socioeconomic report was subsequently filed in January 1990. Provincial and federal environmental agencies have been major participants in the review process, and the reports have also been forwarded to local government, public interest groups, public libraries in the West Kootenays and to government agencies and interest groups in the State of Washington. Upon completion of the Prospectus review, the MPSC determined that a Stage II submission was necessary to address a number of concerns identified during the Prospectus review.

In view of public concerns over the potential environmental impacts of the project, an independent review Panel has been formed. This Panel is established under Section 7 of the British Columbia Environment Management Act and pursuant to the federal Environmental Assessment and Review Process (EARP) Guidelines Order with the federal Department of Fisheries and Oceans being the initiating department. The Panel is expected to complete the Stage II public review requirements of the provincial MPRP and, at the same time, to fulfil the federal government's requirements and responsibilities under its Environmental Assessment and Review Process. The terms of reference for the Panel have been approved by the provincial Minister of Environment and by the federal Minister of Environment.

PANEL MEMBERSHIP

The Panel is comprised of a chairman and two additional members. All three panelists are joint appointments made by the provincial Minister of Environment and the federal Minister of Environment.

.../2

PANEL MANDATE

The mandate of the Panel is to conduct a public review of the environmental and associated social effects of the proposed Celgar Pulp Expansion Project, including any effects that are external to Canadian territory. The primary concerns which have emerged from the project review to date have been connected with the protection of ambient air and water quality, including fish and fish habitat, the availability of surplus wood chips and the impact of additional truck traffic resulting from the transportation of additional wood chips to the mill. The Panel shall focus its review on these concerns.

The impact of the project on the management of provincial Crown forests is not included in the mandate of the Panel. The Company does not possess any rights to harvest timber on Crown forest land and, therefore, purchases its wood fibre requirements from manufacturing operations which have surplus wood fibre supply. The company has stated that all of its wood fibre requirements for the expanded mill operation can be met through accessing by-product chips from area sawmills and from pulp logs produced as a by-product of the area's sawlog harvest. Therefore, the mill expansion proposal is not contingent upon the company securing new sources of fibre supply requiring new timber harvesting agreements.

In fulfilling its mandate, the Panel shall:

1. Conduct public hearings to be held in Castlegar and one or more neighbouring communities;

2. Review the Company's Stage II submission and Prospectus documents and any other written material it deems relevant;

3. Provide for public access to all information provided to or prepared by it; and

4. Prepare a written report with recommendations to the provincial Minister of Environment and the federal Ministers of Environment and Fisheries and Oceans. Recommendations shall be provided on the environmental acceptability of the proposed pulp mill expansion.

The review undertaken to date shall be considered sufficient for the purpose of identifying and determining the scope of the issues raised by the project and, therefore, the Panel is not required to undertake an "issues scoping" step in its review.

.../3

PANEL MANDATE (Cont'd)

If the Panel concludes that the proposal is acceptable, it shall explain the basis for that conclusion and recommend terms and conditions under which the expansion could proceed. If the Panel concludes that the proposal is unacceptable, it shall similarly explain the basis for this conclusion.

No construction activities on the site associated with this mill expansion proposal shall be initiated until after the Panel has completed its review, and then, only if the governments' decision is to allow the proposal to proceed and the proponent has obtained the necessary statutory authorization for commencement of construction.

PANEL REVIEW STAGES

The main stages in the Panel review process shall be as follows:

1. The Panel shall review the Prospectus documents and comments of the public and of provincial and federal agencies resulting from the Prospectus review;
2. The Panel shall ensure wide public distribution of the Stage II submission;
3. The Panel shall invite comments in writing from all interested parties, including federal and provincial agencies, on the Company's Stage II submission within 45 days from the distribution of the Stage II submission;
4. The Panel shall ask the Company as soon as possible to provide supplemental information, if any deficiencies are identified during its review of the Stage II submission;
5. At its discretion, the Panel may also direct specific information requests to federal and provincial agencies;
6. The Panel shall schedule its public hearings as soon as it is satisfied that it has an adequate information base for discussion at the hearings;
7. Public hearings shall be held by the Panel in Castlegar and one or more neighbouring communities. The hearings will be non-judicial, but will be governed by clear rules of procedure;

.../4

PANEL REVIEW STAGES (Cont'd)

8. At its discretion, the Panel may prepare a short interim report shortly after the completion of the hearings with recommendations on whether or not approval-in-principle for the Project should be granted. This report will be submitted to the provincial Minister of Environment and the federal Ministers of Environment and Fisheries and Oceans;

9. The Panel shall prepare a final report with complete recommendations, and submit this to the provincial and federal Ministers; and

10. Following review of the Panel report by the two governments, the report and the governments' decision on the project will be made public.

PROCEDURES

Detailed written procedures for the conduct of the review, including the public hearings shall be established by the Panel and made available to the public as expeditiously as possible. These operational procedures will be submitted to and approved by the Executive Chairman of Federal Environmental Assessment Review Office and the Deputy Minister of the B.C. Ministry of Environment.

TECHNICAL SPECIALISTS

As deemed necessary and appropriate by the Panel, technical specialists may be engaged to assist with the examination and understanding of specific issues. At the discretion of the Panel, these individuals may be made available to other review participants to assist with their understanding of these issues. The Panel's procedures shall contain further detail on the role and availability of these specialists.

SECRETARIAT

A Secretariat shall be established to assist the Panel with the day-to-day management of its activities.

MEMBERS OF THE ENVIRONMENTAL ASSESSMENT PANEL REVIEWING THE CELGAR PULP MILL EXPANSION PROPOSAL

JILL BODKIN (Chairperson)

Ms. Bodkin is Director of Financial Services and a Partner with Ernst & Young in Vancouver. She received a B.A. from the University of Alberta in 1963 and completed M.P.A. studies at Syracuse University in 1979.

The founding Chairman and former C.E.O. of the B.C. Securities Commission, Ms. Bodkin also served as Deputy Minister of Consumer and Corporate Affairs for B.C. from 1981-86. She was a member of the Secretariat to the federal Cabinet Committee on Economic Development and was later appointed to the Sectoral Advisory Group on Trade in Financial Services for the GATT negotiations.

Ms. Bodkin is active in a number of public and private sector organizations including the Vancouver Board of Trade, the Institute for Research in Public Policy, the Swiss-Canadian Chamber of Commerce and the Hong Kong-Canada Business Association.

DR. THOMAS GORDON NORTHCOTE

Dr. Northcote is a Professor in the Institute of Animal Resource Ecology, Westwater Centre and Faculty of Forestry at the University of British Columbia.

He holds a B.A., M.A. and Ph.D. from the University of British Columbia and studied at the University of Cambridge on a National Research Council Overseas Scholarship in 1955-56.

A specialist in the impact of man on inland water ecosystems, Dr. Northcote is a former Director of the Canadian Society of Wildlife and Fishery Biologists, former Chairman of the International Association of Limnology and former Director of the Rawson Academy.

.../2

DR. PAUL R. THOMAS

Dr. Paul Thomas is President of Paul R. Thomas Pulp Consulting, which provides technical consulting services to pulp and paper companies. He received a B.Sc. from the University of Durham, England in 1959 and a Ph.D. from the same institution three years later.

Dr. Thomas has more than 26 years of technical experience in the forest products industry, including 15 years as co-founding partner of Econotech Services Limited, a pulp and paper research development centre.

He is a member of the Canadian Pulp and Paper Association, the Technical Association of the Pulp and Paper Industry and the Chemical Institute of Canada.

APPENDIX C

Supplementary Information Supplied by Celgar

Celgar Pulp Company

P.O. Box 1000
Castlegar, British Columbia
Canada V1N 3H9

Telephone (604) 365-7211
Telex 041-554
Admin. Fax (604) 365-4288
Purch. Fax (604) 365-2218
Traf. Fax (604) 365-4280

March 12, 1990
Ref: JB-90-209

Ministry of Regional Development
Regional Planning and Infrastructure Branch
Fourth Floor
712 Yates Street
Victoria, B.C.
V8V 1X5

Attn: Ms. A. Donnelly, Co-Chairperson
MPRP Steering Committee

Dear Ms. Donnelly:

Please find attached our responses to the concerns expressed by:

1) B.C. MOE
2) West Coast Environmental Law Association
3) C.I.P.E.
4) City of Castlegar

We have also included the draft report on an archeological survey, a wood furnish analysis, and a chip transportation study.

The references attached are representative of the sources used to arrive at the technology and emission rates reported.

We trust this is the material required and are prepared to provide further input if the need arises.

Sincerely,

J. E. Browne
General Manager
Celgar Pulp Company

JEB/vad
attach.

A. MOE CONCERNS

Reference: Ministry of Environments' comments to
- D. Parsons, Aldyen Donnelly
Date: 03-05-90

Reference to APPENDIX of above report

1.0 Effluent

1.1 - High grade papers require lignin-free pulp. With the present softwood kraft technology, the only satisfactory method of eliminating lignin while maintaining acceptable pulp quality is to use a minimum of 30% gaseous chlorine in the first bleaching stage. The industry feels that hydrogen peroxide may be a partial solution to this problem and Celgar in designing the new bleach plant have allowed for the introduction of hydrogen peroxide in the oxidation extraction stage.

- Latest reference re: hydrogen peroxide is taken from the January, 1990 CPPA Technical Conference. Paper is entitled, "Hydrogen Peroxide Technology For Chlorine Reduction," by J.R. Anderson and D.L. Carmichael of DuPont Canada Inc.

1.2 & 1.3 - Regarding AOX in Effluent and Biosolids

- As suggested by Greenpeace in the 1989 handout, "Toward Chlorine-Free Paper", the true solutions of oxygen pre-bleaching, prolonged cooking, better washing of pulp prior to bleaching, partial replacement of chlorine gas by chlorine dioxide (high substitution), bleaching to a lesser degree and secondary effluent treatment and confirmed by the Pulp and Paper Research Institute of Canada and CIL Inc. regarding "The Effects of Secondary Treatment on AOX Levels in Kraft Mill Effluents," as well as Econotech's Services Ltd. in "AOX Testing of Bleach Plant Effluents", the Celgar design will result in AOX levels below 1.5 kg/Admt as required by the December 31, 1994 target. Furthermore, the research by C-I-L indicates that secondary treatment results in substantial reduction in all classes of AOX.

- With respect to effluent treatment biosolids, reference is made to "Studies on Characterization, Fate, and Impact of Residual Solids of Biological Treatment Origin:, by H.S. Costa, J.J. McKeown and R.O. Blosser; "Non-Settleable Suspended Solids: Their Impact on Receiving Waters", By E. Lee, J. Mueller and C. Walden; "A Discussion of the Use of the AOX Parameter as a Tool for Environmental Protection", by B.I. Fleming, et al of PPRIC which indicate that normal residual solids of pulp and paper industry biotreatment origin are insignificant as a pollutant parameter.

1.4 - Information previously filed with MOE in Nelson, indicated that testing undertaken at a U.S. pulpmill using an extended aeration activated sludge system produced non-acute toxic effluent.

.....2

1.5 - The majority of present day's resin acid levels to sewer are from unbleached white water and black liquor spills to sewer. In the modernized mill, provision has been made for extensive in-plant spill recovering and spill diversion to 24 hour spill ponds as well as complete capture of the unbleached white water. Also the installation of secondary effluent treatment will result in the forecasted resin acid level of 20 kg/d.

1.6 - The present colour in effluent is attributable to unbleached white water in sewer plus the first caustic filtrate in the bleach plant. With the improvements listed in 1.5 plus oxygen delignification and high chlorine dioxide substitution, PPRIC predict a reduction of 75% in the colour originating in the first stage bleach plant filtrate. See the reference "Modifying the Bleaching Process to Decrease AOX Formation."

1.7 - This will be addressed at the permitting stage as well as detailed engineering design.

2.0 Receiving Water

2.1 - No further comment.

2.2 - In discussions with MOE reps. from Nelson, it was agreed that these issues would be dealt with during the permitting, licensing stage since river bottom deposits are due to operation of the existing mill.

2.3 - No further comment

2.4 - Our consultant (E.V.S.) will respond as soon as literature survey is completed.

2.5 - This is now underway with sampling program completed and analyses now in the hands of the various laboratories.

3.0 Air Contaminant Emissions

3.1 Production Rate:

a) Instantaneous = 1325 ADt/day

b) Annual average based on 91% availability = 1200 ADt/day or over 350 operating days = 420,000 ADt.

c) Unbleached instantaneous production based on approximately 5.3% shrinkage = $\frac{1325}{0.947}$ = 1398 ADt/day

3.2 - Our consultants will respond to this query

3.3 - Willing to comply but clarification of query required. Equipment suppliers must provide performance guarantees for their equipment.

.....3

3.4 - Our consultants will respond to this query

3.5 - Our present lime kiln indicates no SO_2 emission during the combustion of LVHC gases.

3.6 - Celgar proposes to pursue the possibility of firing higher liquor solids to the recovery boiler. As a consequence, the new multiple effect evaporators have been designed to produce 75% solids. The following data obtained from a mill operating in Pols, Austria indicated that by increasing the solids from 65% to 75% decreased the SO_2 output from 400+ppm to a range of 40-60ppm.

3.7 - The largest source of TRS emissions are the bio-ponds which we cannot justify shutting down. SO_2 could possibly be controlled by reducing the recovery boiler throughput. This facility has been designed with 5% excess capacity to alleviate such a situation.

3.8 - Cooling mechanism in ponds and/or cooling towers is identical and is based on the evaporation of the liquid to be cooled. Therefore, for a degree of cooling, the amount of water vapour produced is identical for both technologies. The ponds have been selected to produce a shallow, large surface area cooling device which results in lower energy consumption per unit of cooling.

4.0 Air Quality

Section 4-0 has been communicated to CIRRUS for review and response.

5.0 Solid Waste

In regards to the issue of leachate, Celgar is prepared to perform soil perculation studies to assess the extent of any problem and aid in designing solutions in communication with MOE. This work will be performed after startup of the new plant.

6.0 Storm Water Runoff

Celgar is prepared to discuss storm water collection or diversion with MOE reps.

7.0 Water Supply

There will be no increase in water requirements for the new plant.

8.0 Glossary

A glossary was included in Appendix 6 of the E.I.A.

.....4

B. **WEST COAST ENVIRONMENTAL LAW ASSOCIATION**
Reference: Letter dated February 14, 1990 to Mr. D. MacDonald and Mr. J. Browne

Upon reviewing this letter we have identified the following additional concerns.

1. Full public hearings
   - Celgar cannot respond to this

2. Intervenor funding
   - Comment as above

3. Target date for zero kilograms of AOX
   - Technology has not developed to the point where this can be predicted

4. Monitoring program
   - MOE and Celgar will design monitoring programs for the new mill during the permitting stage

5. Increased harvesting of pulpwood
   - Celgar, at present, does not harvest any wood. The expansion plans are based on the purchase of fibre on the open market. Should PA Number 9 remain advertised, Celgar will participate in the process either as a proponent or an intervenor.

6. Antistain Contamination
   - All purchased chips are sampled routinely for quality and foreign material. Celgar's fiber buyer continually visits sawmills to monitor their operation.

7. Foreshore Filling Project
   - This project is being performed under the Provincial and Federal regulations

8. PCB filled transformers and storage areas
   - Celgar has complied with all Federal and Provincial regulations. The new plant will not use PCB equipment or asbestos insulation.

9. December 31, 1991 AOX guidelines
   - MOE has recognized and accepted that the lead time required for mill design and construction precludes the attainment of the 1991 level. (See MOE's revised Page 1).

10. Monitoring of uncontaminated cooling water
    - To be undertaken re: conductivity and oil

11. Location of bio-ponds
    - No space available at immediate mill site

12. Impact of low river flow
    - EIA impacts were basically carried out at low flow conditions

.....5

13. Chlorate effects
   - Other operating mills have discovered that secondary effluent treatments destroy chlorate.

14. Storage of logs on river
   - Logs will be stored as directed by MOE

15. Landfill Operation
   - Celgar has and will continue to operate to a level A objective

16. Independent river monitoring
   - Celgar is involved in a joint monitoring program which includes B.C. Hydro, Cominco and the Provincial Government

17. Start-up procedures and discharge containment
   - This will be part of the permitting procedures

18. Emergency response plan
   - Celgar has already a plan in place which will be upgraded to incorporate the requirements of modernization. The emergency/spill response plan is registered with the Provincial MOE.

19. Transportation
   - Celgar will continue to review all forms of transportation available and will continue to use those modes of transportation which are efficient and economical

C. C.I.P.E.

Reference: Letter dated February 10, 1990 to Mr. D. MacDonald as prepared by W. Peppard

The only topic not discussed previously is with reference to recycling waste paper. Celgar is not proposing to build a paper mill and therefore are unable to comply with the request to use recycled paper.

D. CITY OF CASTLEGAR

Reference: Memorandum to City Council from S. Knoerr, Chairman of the Celgar Expansion Advisory Group

1. Fog and Haze
   - Celgar in their proposal has endeavoured to use dry collection air cleaning devices in order to insure that the emissions will be as hot and dry as possible to optimize dispersion and minimize occurences of fog and haze.

2. Effluent Pond Leaks
   - the ponds will be constructed according to the rules and regulations of the pertinent regulatory agencies.

.....6

3. Downstream use of Columbia River re: potable water
   - The modernization will result in an improvement in taste, odour, colour and other contaminants which will result in an improvement in the Columbia as a potential potable water source.

4. Highway screens
   - Celgar agrees that planting trees and other vegetation as highway screens is possible and desireable

5. Co-Generation
   - The modernization plan includes a co-generation facility which will expand all 900 psi steam while cogenerating 55 MVA electrical energy.

Further References

1. Arcas Consulting - Archeologist's letter dated March 7, 1990 re: impact assessment

2. Preventing the Formation of Dioxins During Chemical Pulp Bleaching - R.M. Berry, et al of PPRIC.

3. Howe Sound Reduces Dioxin to Nearly Undetectable Levels - American Papermaker, December 1989 issue.

WEST KOOTENAY FIBRE SUPPLY OPPORTUNITIES

OVERVIEW

The forests of the West Kootenay region contain a high quality component (sawlogs) as well as a low quality component (pulplogs). High quality in practice means those logs which can be profitably made into lumber and low quality are those logs which find their highest end use as wood chips for the manufacture of pulp.

The Celgar mill, opened in 1960, was conceived as an attempt to salvage recoverable wood volumes from the decaying hemlock/cedar forest of the interior wet belt. The sawlogs were utilized in the sawmill and the pulplogs were directly manufactured into chips in the pulpmill woodroom.

In the beginning, the woodroom produced 60% of the pulpmill fibre requirements. Since that day, the production of wood chips as a by-product of lumber production has displaced the use of the pulplogs at the Celgar mill. (See Attach #1)

Independent sawmills from the West and East Kootenays and the Okanagan have shipped byproduct wood chips to Celgar in the past. Currently the supplies of byproduct woodchips have reduced our supplier group and eliminated the use of pulplogs at Celgar. (See Attach. #2)

Additional Southern Interior pulping capacity will reduce or eliminate the byproduct woodchips which currently move elsewhere and allow usage of the pulplog resource currently exported. Today and tomorrow the usage of the regional fibre potential could contribute to improved forest utilization, improved sawmill economic viability, reduced exports of raw materials and improved operations at Celgar, environmentally and economically.

FIBRE REQUIREMENTS

The expanded pulpmill at Castlegar is expected to require 2,437,000m³ of wood chips. Table I compares the requirements of the existing plant with those of the new plant.

TABLE I

PRESENT AND FUTURE FIBRE REQUIREMENTS**

	Current	,000m³	Future
Byproduct Chips			
Long Term Contracts	320*		1610
Open Market Purchase	710		587
Pulp Logs	-		240
Total	1130		2437

*Westar sawmill adjacent to pulp mill.
** See Attach. #3

.....2

FIBRE SOURCING

In the Southern Interior of B.C. the existing pulp industry cannot consume the by-product chips produced by area sawmills. Coupled with the fibre supply available from low quality logs associated with West Kootenay forests, the potential to increase the pulping capacity of the existing pulpmills is significant.

Pulp quality fibre has been identified in several broad groups:

a) By-product chips from sawmills

b) Low quality logs, unsuitable for the manufacture of lumber, harvested during the normal regional sawlog harvest. The trees from which these logs come are usually dead or dying from one of the natural causes of tree death.

c) Low quality stands of timber not presently included in the apportioned crown timber available for harvest.

d) Increased use of logging waste in the production of by-product woodchips.

As supply economics dictate, the increased use of roundwood and development of fibre from logging waste will evolve in the longer term.

VOLUME IDENTIFIED

In November, 1989, the Forest Service released a report in which they estimate that the S.E. Interior has the potential fibre to produce additional kraft pulp production of 2,995 metric tonnes per day of which 850 metric tonnes per day are in the West Kootenay region.

By-product Wood Chips

Stone Consolidated Inc. (previously know as Consolidated-Bathurst Inc.), following the purchase of Celgar in 1986 became increasingly aware that southern B.C. offered one of the last under-utilized areas of long fibre wood in North America.

They arranged for Industrial Forestry Service Ltd. of Prince George, B.C. to undertake an assessment of the potential. The study confirmed a potential supply of fibre not consumed domestically or underutilized as a result of the current fibre balance in the area.

Table II illustrates the volume of by-product chips potentially available from sawmills to a pulpmill situated at Castlegar from the S.E. interior B.C. and U.S. sources. (See Attach. #3)

Naturally, Celgar will modify the potential plan to reflect our specific economic and species criteria.

.....3

It is estimated (B.C. Ministry of Forests) that 1.6 million cubic meters of wood chips leave the S.E. interior for coastal, Pacific Rim and U.S. PNW pulpmills. The current by-product chip production from area sawmills easily satisfies the demand for wood chips by the existing plants in Castlegar, Skookumchuk, and Kamloops. In fact the closure of the Celgar woodroom in early 1988 is testimony to the overwhelming chip supply.

Low Quality Logs (Pulplogs)

The pulplog potential of the S.E. interior is significant. A recent Forest Service study estimates the annual volume available at 1,295,200 cubic metres. This volume does not include the substantial volumes not currently considered part of the apportioned annual harvest.

TABLE III

ESTIMATE OF POTENTIAL ANNUAL FIBRE VOLUME FROM PULPLOGS INCLUDED IN THE AAC LAND BASE
000,m^3

AREA	
Kamloops	703.5
West Kootenay	395.7
East Kooteany	195.9
	1295.2

Source: S.E. British Columbia
Fibre Resource Study
Ministry of Forests

FIBRE SECURITY

The Celgar Pulp Company is unique in British Columbia in that it does not directly control, manage or have direct access to Crown or private forests.

Its fibre security is dependent on:

a) a long standing relationship with independent sawmills of the area

b) A geographic position relative to the fibre supply which makes it difficult for other suppliers to effectively compete on price.

.....4

c) An ability and a willingness to utilize all of the 13 commercial tree species found in the supply area

It is the intention of the Company to cement our relationship with some suppliers by signing long term contracts.

The long term contract is designed to provide a minimum cancellation notice of five years, under normal circumstances. This approach will ensure a minimum of five years security with each of our long term suppliers. In the case of Westar Timber, which owns a large sawmill on property next to the pulp mill, we are seeking a 10 year evergreen provision.

Payment is made on the basis of a percentage of the price received by Celgar for one tonne of pulp. This provides both the supplier and Celgar with a market-sensitive pricing mechanism and assists in a harmonious working relationship.

These contracts will be further supported by application to the Provincial Government for a fibre guarantee known as a pulpwood agreement. This process is now underway.

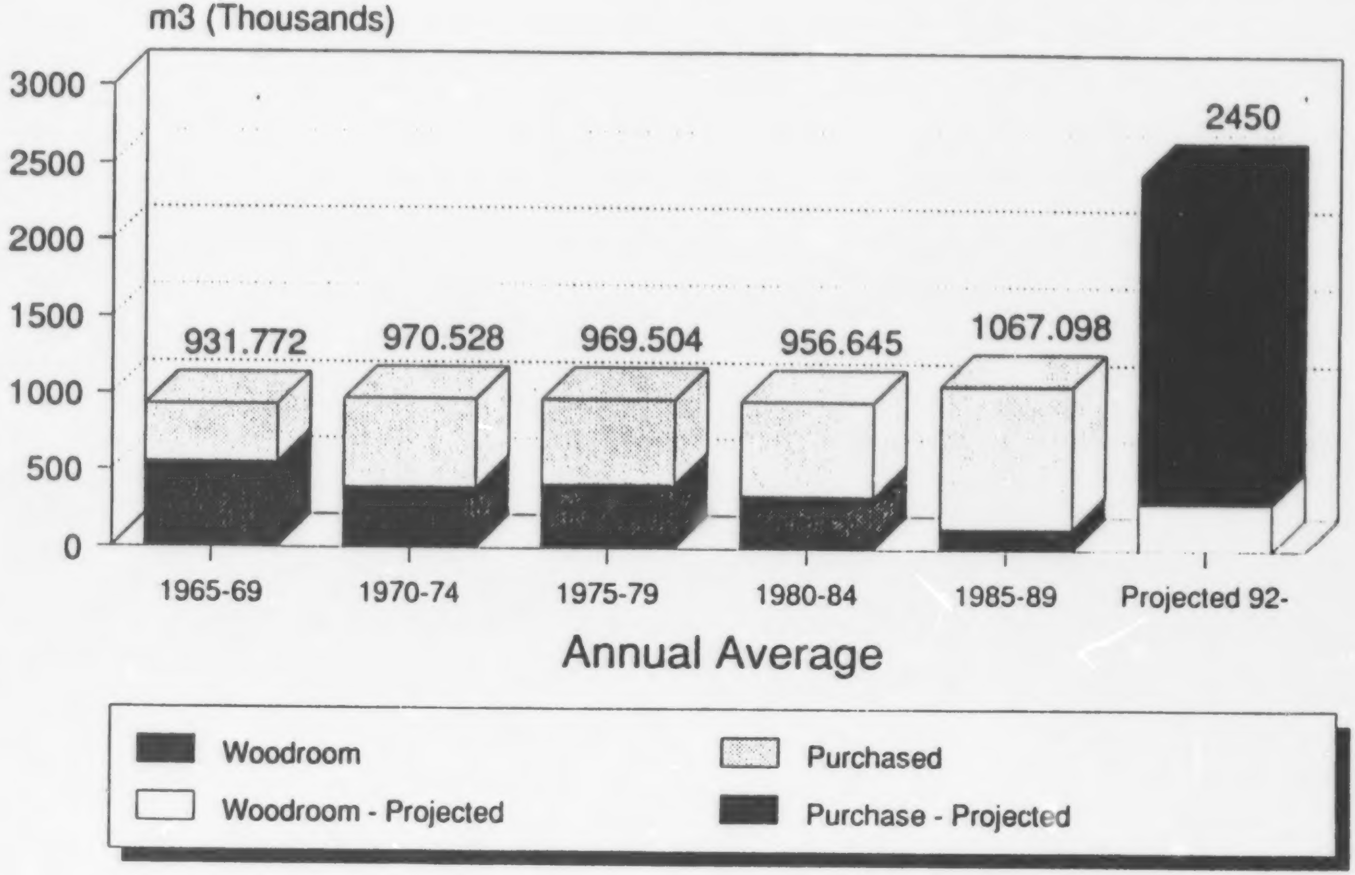
CONCLUSION

The Celgar Pulp Company is well positioned to take advantage of the S.E. B.C. fibre opportunity because:

1. The government goal of maintaining a thrifty independent sawmilling sector would be well served by ensuring that Celgar remains fibre secure without direct access to government (crown) wood.
2. Celgar Pulp Company has moved to ensure expansion ahead of any other proposals.
3. In a region of frequent and sustained economic difficulty the Celgar West Kootenay Project adds to the economic independence of the region.
4. The fibre available in the Southern Interior of British Columbia represents a unique opportunity to modernize and expand the pulpmill at Castlegar.

ATTACHMENT #1

Historical Summary of Supply



LIST OF REFERENCES

Holm, V.A. and Laurie, D.M. 1989 Southeast British Columbia Fibre Resource Study. Ministry of Forests, Victoria.

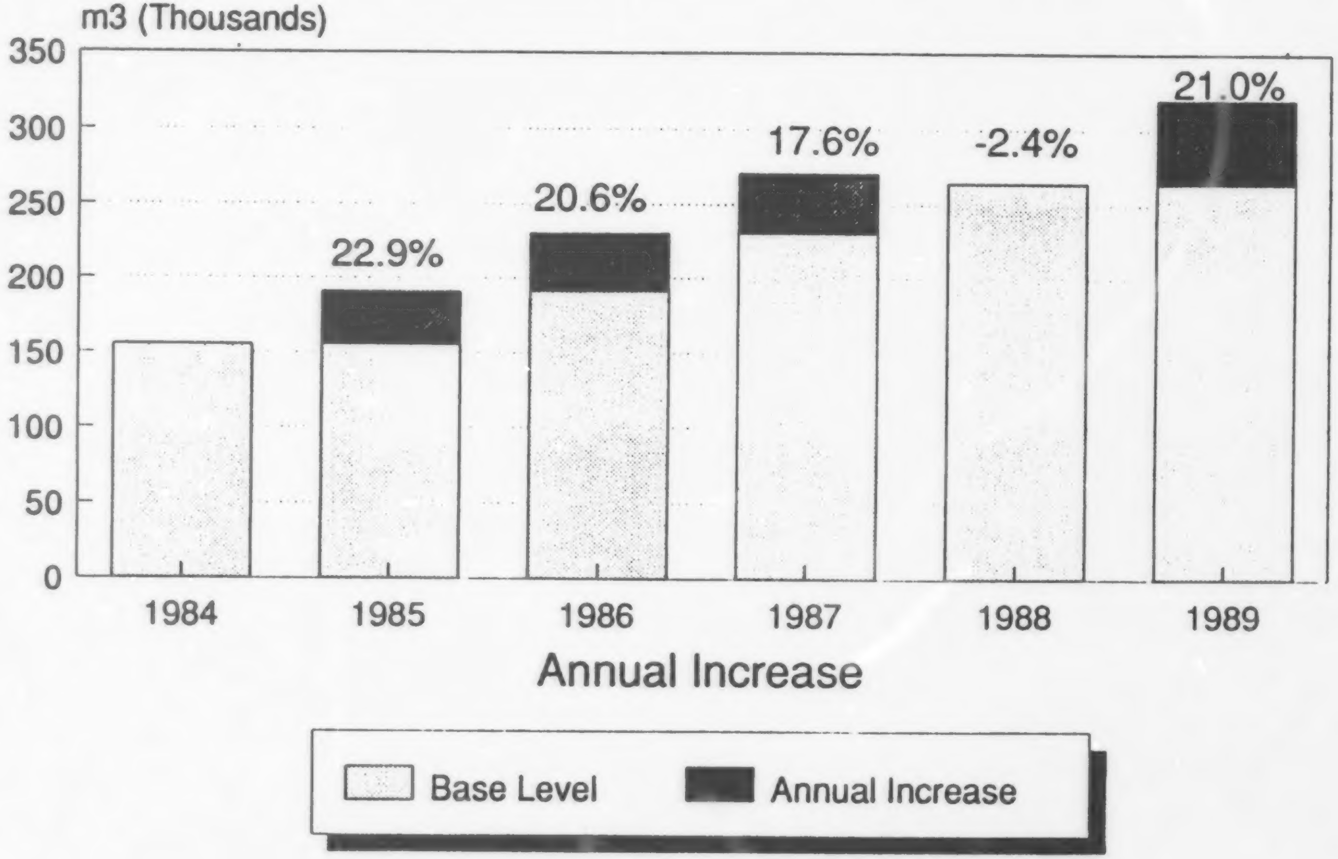
Appleby, P.W. 1989 Pulp Chip Availability in British Columbia: 1987 (FRDA Report, Iss. No. 835-0752;061)

Enifelt, F. 1988 Fibre Supply Analysis - Southern Interior B.C. Industrial Forestry Service Ltd., Prince George

ATTACHMENT #2

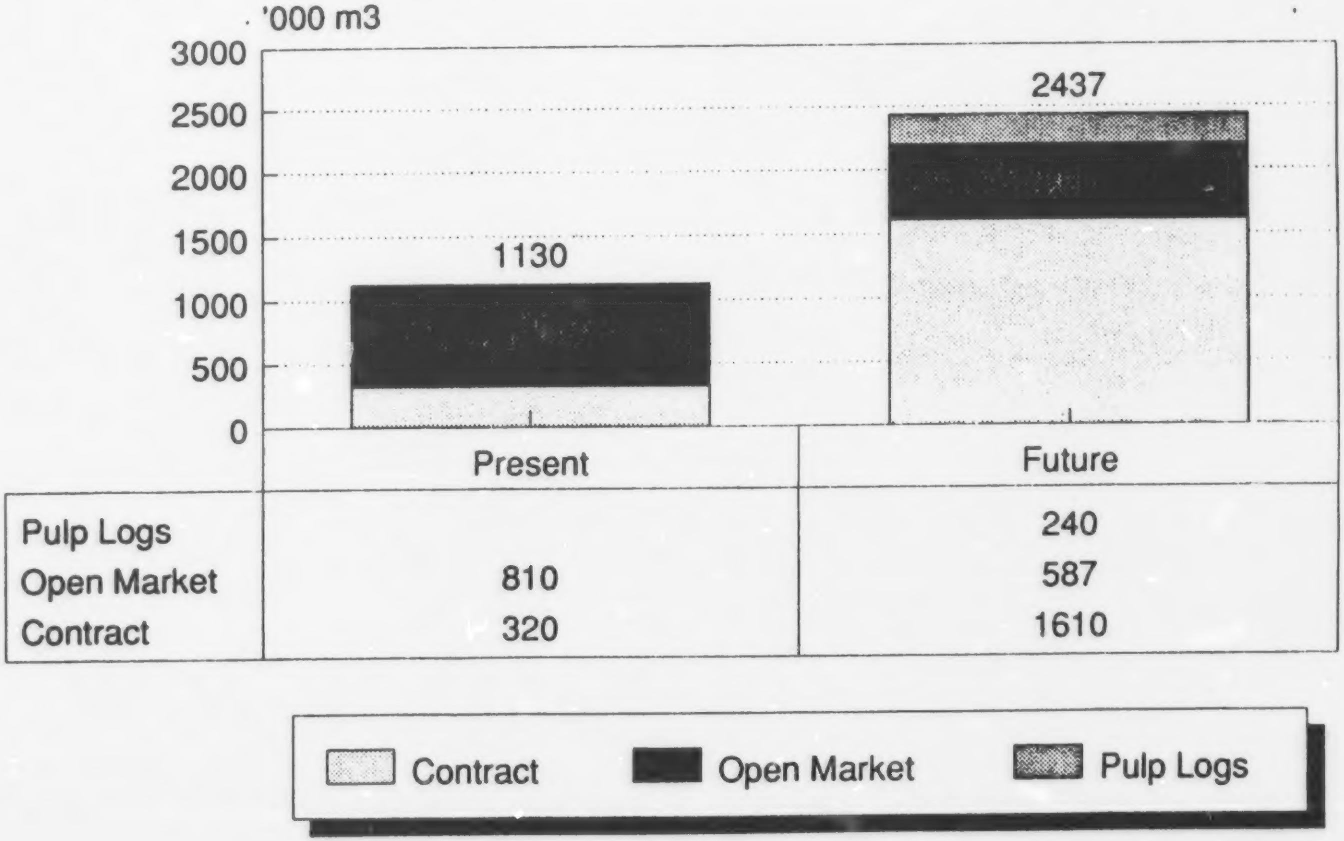
Delivery History (1984 - 1989)

Westar Timber / S.W.P.



ATTACHMENT # 3

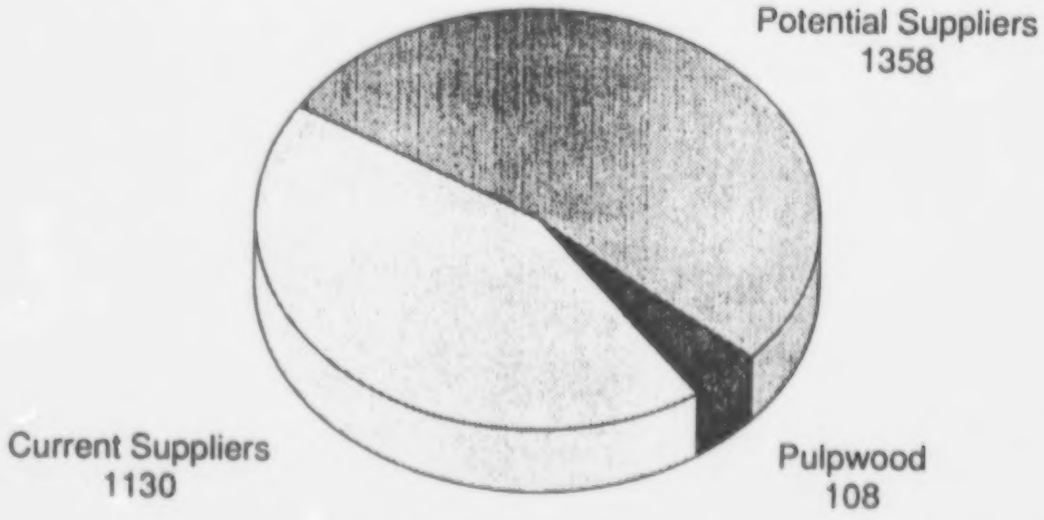
Present and Future Annual Fibre Requirements



	Present	Future
Pulp Logs		240
Open Market	810	587
Contract	320	1610

ATTACHMENT #4

By-product Woodchips & Pulpwood Estimates



TOTAL 2,596,000 m3

Source: Industrial Forestry Service

WOODCHIP TRANSPORTATION

OVERVIEW

Transportation of offsite woodchips to the existing Celgar mill at Castlegar is accomplished using trucks. Our competitors to the east and west also move most of their woodchips using trucks. The eastern competitor continues to receive small volumes by rail.

The modernization and expansion project at the Celgar mill was developed based on the use of trucks to move woodchips.

History

Following the completion in 1960 of Celgar Pulp, the first inland pulpmill in British Columbia, area sawmills began to produce byproduct woodchips from lumber manufacture. The independent sawmill supply grew until the Celgar woodroom closed at year-end, 1987. The volume of chips needed to replace the woodroom supply arrived by truck.

The transportation of off-site fibre has evolved in the following pattern:

	Rail	Truck
1970	80%	20%
1982	70%	30%
1986	60%	40%
July, 1989	0%	100%

The trend away from rail transportation was affected by:

- the aging railcar fleet

- the competitive rates from trucks on the short hauls (Grand Forks, Midway, Slocan).

The railroad have indicated an interest in quoting on the longer chip hauls in the future.

Introduction

The Celgar Pulp Company are not in the transportation business. We have traditionally utilized carriers in the private sector whose primary business is transportation.

The pulp output of the Celgar plant moves to market by railroad. This transportation method will continue as long as the service is available at acceptable levels and competitive prices.

.....2

Woodchip Transportation Requirement

The volume of wood chips required by the modernized plant is expected to be 2,437,000 cubic metres. We currently anticipate that the woodchips produced on site will reduce the transportation requirement to 2,165,000m³.

Total Off Site Volume	2,165,000m³
Anticipated Average Load Size	40m³
Total Annual Trucks Required	54,125

Woodchip Sourcing by Highway Route

Highway 3W (Grand Forks)	18,900
Highway 3E (Salmo)	12,420
Highway 3A (Slocan-Nelson)	19,980
Highway 22 (Trail)	2,700
	54,000

ALTERNATIVE TRANSPORTATION METHODS

Railroad

The railroad have indicated an interest in providing cost estimates on approx. 450,000m³ or 21% of the off site fibre requirements.

Use of this alternative has the added requirement of infrastructure (unloading) modifications at Celgar Pulp but would reduce the total truck requirement by 11,250 trucks/year.

Marine Transportation

The Arrow Lakes is an impounded water way which bisects the West Kootenay Region from north to south. Traditionally, the waterway has been used for the movement of roundwood (pulp & saw) to the pulpmill and sawmill in Castlegar.

This transportation alternative could be used to move the volume identified as tributary to rail. Serious consideration of this option is not planned until it is established that rail is not competitive with trucks.

Road (Truck) Transportation

A responsive and competitive woodchip purchase program is best served by a flexible transportation alternative. Truck transportation offers the flexibility of service and price and all potential suppliers can be served.

.....3

CONCLUSION

Celgar Pulp Company plans to seek the most competitive and flexible approach to woodchip transportation. The alternatives can be thoroughly assessed prior to the proposed mill start up in 1992-1993.

We have made representations to government on numerous occasions regarding the regional transportation infrastructure problems and opportunities.

MAJOR ISSUES REGARDING TRANSPORTATION ALTERNATIVES

Rail Transportation (Long Hauls Only)

- Infrastructure changes at Celgar Pulp to accommodate rail cars
- Purchase or lease of a fleet of rail cars ($5-6,000,000 per annum)
- Maintenance of the chip car fleet would be required.

Road Transportation

- Increased use of the existing highways in some locations is not acceptable to local residents.
- Equipment costs are included in the cost of transportation
- Flexible and responsive to changes in suppliers or new suppliers

Marine Transportation

- The annual rise and fall of the Arrow Lakes can be as much as 70 feet. A factor which affects the necessary infrastructure requirements at loading and unloading sites.
- Infrastructure costs are anticipated to be 7-12 million dollars
- The reservoir is subject to periodic freezing in winter(6-8 weeks)
- Truck transportation to a chip reload on the Arrow Lakes would be required

MODIFYING THE BLEACHING PROCESS TO DECREASE AOX FORMATION

N. LIEBERGOTT, B. VAN LIEROP, A. NOLIN,
M. FAUBERT, J. LAFLAMME

PULP AND PAPER RESEARCH INSTITUTE OF CANADA
570 ST. JOHN'S BLVD., POINTE CLAIRE, QC, H9R 3J9

ABSTRACT

This report describes the effects of Eo, Eop and O-delignification and of a wide range of chlorine dioxide substitution levels in the chlorination stage on the properties of pulp and bleach effluents. An eastern Canadian spruce-fir-pine kraft pulp was bleached by a "C"EoDED sequence and a western hemlock kraft pulp was bleached by a "C"Eo(DN)D sequence with and without the various delignification stages.

The AOX in the bleach effluent from the eastern pulp was below 2.5 kg/air-dry metric ton bleached pulp (ADTBP) when using a 90% chlorine dioxide substitution in the "C" stage applied to brownstock or Eo-delignified pulp, 70% substitution applied to Eop-delignified pulp, and 50% substitution applied to O-delignified pulp. The western hemlock brownstock required a 70% chlorine dioxide substitution in "C" to obtain less than 2.5 kg AOX/ADTBP; on Eo and Eop delignified western hemlock pulps a 50% substitution was adequate whereas after an O-delignification stage only 10% chlorine dioxide substitution was required in the 'C" stage to reach 2.5 kg AOX/ADTBP.

Increasing the chlorine dioxide substitution to 70% produced less chlorinated phenolic compounds in the bleach effluents. The effluents were also less coloured and less toxic to fish. The BOD and COD in the effluent decreased only with very high chlorine dioxide substitution levels.

KEYWORDS

BLEACHING, CHLORINE, CHLORINE DIOXIDE, PULP PROPERTIES, EFFLUENTS, BLEACH PLANTS, DEGREE OF SUBSTITUTION, TOXICITY, DELIGNIFICATION, TOTAL ORGANIC CHLORINE, ADSORBABLE ORGANIC HALOGEN.

INTRODUCTION

As the demand for a bleached chemical pulp with a high and stable brightness, good cleanliness and good strength properties increases, so too does the need to improve production capacity and to upgrade existing bleach plants. In the quest to improve the efficiency of pulp bleaching, consideration must be given to curtail the effluent load emanating from the bleach plant.

Most of the chlorinated organic substances in the effluent originate in the chlorination and alkali-extraction stages of a kraft pulp bleach plant (1-5). The formation of these substances in the effluent is mainly attributed to the consumption of elemental chlorine originating from Cl_2 and/or ClO_2 (6,7). This consumption can be decreased by:

a) replacing chlorine in the chlorination stage (partly or fully) with chlorine dioxide (7),
b) delignifying the pulp as much as possible before the chlorination stage to decrease the residual lignin in the pulp (8), and
c) by treating the effluent from the bleach plant in aerated lagoons (9, 10).

Chlorinated compounds in an effluent can be measured by several techniques (4,5); of these the TOCl (total organic chlorine) and the AOX (adsorbable organic halogen) procedures are the most common. The AOX procedure is becoming the preferred technique, although there is still some debate about this issue.

The objective of the present work was to determine to what extent the AOX in the bleach effluents can be lowered when a bleach sequence is preceded by (i) an alkaline oxidative extraction stage (Eo), (ii) an Eo stage with peroxide added to it (Eop) or (iii), a conventional oxygen delignification stage. A wide range of chlorine dioxide substitution was used in the chlorination stage. The potential application of such data is that an existing mill may be able to improve the quality of its effluent by resorting to a less capital intensive Eo or Eop stage rather than to a highly-pressurized oxygen delignification stage.

EXPERIMENTAL

An eastern Canadian spruce-balsam fir-pine commercial kraft pulp (kappa number 30.0; 0.5% cuene viscosity 29.2 mPa.s) and a western Canadian hemlock kraft pulp (kappa number 27.6; viscosity 26.7 mPa.s) were used in the bleaching experiments. The pulps were well washed prior to kappa number measurement and were then delignified using an oxidative extraction stage (Eo), a peroxide reinforced extraction stage (Eop) or an oxygen delignification stage (O) to respective kappa numbers which were approximately 23%, 33%, and 46% lower than that of the brownstock. The Eo, Eop and O-delignification stages were done in a specially designed laboratory mixer which is described elsewhere (11).

In the subsequent chlorination stage, the chlorine:chlorine dioxide ratios were varied from 100:0 to 0:100. In the $C_{90}+d_{10}$ and $D_{90}+c_{10}$ stages, the chlorine and chlorine dioxide were added to the pulp simultaneously; in the $D_{50}C_{50}$ and $D_{70}C_{30}$ stages, the chlorine dioxide was added one minute before the chlorine. The total available chlorine charge in the chlorination stages was based on a chlorine multiple of 0.22 (eastern pulp) or 0.21 (western pulp). We define the chlorine multiple as the chlorine charge (as available chlorine in percent on pulp) divided by the kappa number of the pulp entering the chlorination stage. Bleaching of the chlorinated pulps was then completed with an EoDED (eastern pulp) or an Eo(DN)D (western pulp).

The conditions used in each of the bleaching stages are listed in Table I. In the neutralization step (N), a sodium hydroxide solution was mixed into the pulp at 2% consistency and at 60-65°C immediately after the D1 stage. After a 2-minute-treatment at a pH of just below 10, the pulp was washed and treated in a final D stage. This procedure is meant to simulate addition of NaOH solution to the dilution ring at the bottom of the D1 tower in a bleach plant to remove the residual chlorine dioxide and reactivate the pulp to further bleaching. The significance of the (DN)D sequence is that the (DN)-treated pulp is washed on the D1 washer. This releases the E2 mixer, tower, and washer for use in an Eo or an Eop delignification stage prior to the chlorination stage.

TABLE I
BLEACHING CONDITIONS

Stage			Consistency, %	Time, min	Temp., °C	Pressure, psig	Time at Pressure, min
Pre-chlorination	Eo		10	60	80	50	10
	Eop		10	60	80	50	10
	O		10	60	80	100	60
Chlorination	C+d		3.5	30	40	—	—
	Dc	D	6.0	1	50	—	—
		C	3.5	29	40	—	—
Post-chlorination	Eo		10	60	60	30	10
	D_1 & D_2		10	150	60	—	—
	E_2		10	60	60	—	—
	N		2	2	60	—	—

C+d: Chlorine and chlorine dioxide mixed together before being added to the pulp.
Dc : Chlorine dioxide added to pulp one minute before the chlorine.
E_2 : used in the sequence CEoDED on the Eastern Canadian pine-spruce-fir kraft pulp; NaOH charge, 0.5% on pulp, OD basis.
N : used in the sequence CEo(DN)D on the western hemlock kraft pulp; NaOH charge, 0.3% on pulp, OD basis.

The effluents from each stage were collected after diluting the pulp to a consistency of 3.5% and mixing for approximately one minute. CPPA standard testing methods were used to measure the BOD, COD and colour. The total organic chlorine (TOCl) was determined using a titration method for chloride analysis (7). The TOCl values so obtained were converted to AOX by using formulae developed from a bank of corresponding TOCl and AOX determinations made at Paprican (see Appendix). AOX values were obtained using a Dohrmann DX20 analyzer. The chlorinated phenolics were measured using capillary GC-ECD analytical techniques (12).

RESULTS AND DISCUSSIONS

Pulp Properties after Delignification and Bleaching

The spruce-balsam pine-fir kraft pulp (kappa number 30.0) was delignified using an oxidative extraction stage (Eo), a peroxide reinforced extraction stage (Eop) or an oxygen delignification stage to kappa numbers of 23.4, 20.5 and 16.6, respectively (Table II). The western hemlock pulp (kappa number 27.6) was delignified to kappa numbers of 21.1 using an Eo stage, 18.5 using Eop, and 14.6 using an O-stage (Table III). While the O-stage was best at delignifying the pulp, the milder conditions of the Eo and Eop delignification stages had a less severe effect on pulp viscosity.

The amount of chlorine dioxide applied in the chlorination stage influenced the kappa number obtained after the chlorination and oxidative extraction stages (Figure 1). A $C_{90}+d_{10}$Eo treatment of the brownstock resulted in a kappa number of 3.4 (spruce) and 4.6 (western hemlock). With an Eo, Eop and O-delignification before $C_{90}+d_{10}$, the kappa numbers of both extracted pulps were lowered to 2.7, 2.4 and 2.1 respectively. When the chlorine dioxide:chlorine ratio was increased to 70:30 there was little or no effect on the kappa number after DcEo. When the ClO_2:Cl_2 ratio was raised to 90:10 or 100:0, the kappa number after the extraction stage of all pulps (except the oxygen-treated spruce pulp) increased sharply.

The extent of delignification before DED or (DN)D influenced the bleaching response to these stages. The more the pulp was delignified before the chlorination stage, the higher the final brightness considering the chlorine dioxide application in the D stage. As the chlorine dioxide substitution increased, however, the ISO brightnesses of the fully-bleached pulps decreased; this was especially true for the spruce pulp

TABLE II
DELIGNIFICATION AND CEoDED BLEACHING OF A SPRUCE-BALSAM FIR-PINE KRAFT PULP

					Chemicals added, kg/mtp, OD basis				Properties				
Pre-Treatment	Kappa No.	Visc., mPa.s	C-stage Type	Kappa Factor Cl_2 alone	C-stage Cl_2	C-stage ClO_2	D_1-stage ClO_2	Total NaOH	kg/ADTBP of TOCl	kg/ADTBP of AOX	Kappa No. after CEo	Viscosity, mPa.s	ISO Brightness after D_1, %
None	30.0	29.2	$C_{\text{[illegible]}}d_{\text{[illegible]}}$	0.22	66.0	0	12	39	6.8	6.7	3.5	20.4	92.3
			$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.20	39.4	2.5	12	37	5.9	5.9	3.4	25.6	92.1
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	33.0	12.6	12	33	4.8	4.7	3.4	26.3	91.3
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.07	19.8	17.6	12	30	4.0	3.9	3.5	26.7	91.6
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	6.6	22.6	12	27	3.2	2.2	4.6	28.1	90.8
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0	0	25.1	12	25	2.7	1.7	4.9	28.3	90.6
Eo	23.4	27.4	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.20	46.3	2.0	7	45	3.4	3.2	2.7	21.6	92.1
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	25.8	9.8	7	39	3.8	3.7	3.3	21.5	91.5
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.07	15.4	13.7	7	35	3.2	3.2	3.2	21.7	91.2
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	5.1	17.6	7	33	2.2	1.3	4.5	22.1	91.2
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0	0	19.6	7	33	1.8	1.0	4.6	22.3	90.8
Eop	20.5	26.3	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.20	40.6	1.7	7	45	4.8	4.6	2.4	23.9	92.2
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	22.6	8.6	7	39	3.1	3.0	3.0	24.2	91.9
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.07	13.5	12.0	7	35	2.3	2.3	3.4	24.8	91.1
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	4.5	15.4	7	33	1.5	0.9	4.3	24.8	90.8
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0	0	17.2	7	33	1.0	0.5	4.3	25.0	90.7
O	16.6	21.2	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.20	33.0	1.4	6	38	4.1	3.9	2.1	19.8	92.4
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	18.3	6.9	6	33	2.5	2.4	2.8	20.1	91.9
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.07	11.0	9.7	7	30	1.5	1.6	2.9	20.6	91.7
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	3.6	12.5	7	29	0.8	0.4	3.2	20.7	90.8
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0	0	13.8	7	28	0.5	0.3	3.5	20.7	90.4

mtp = metric ton pulp (OD basis)
TOCl and AOX measurements are reported on air-dry metric ton bleached pulp basis.
AOX values were derived from TOCl measurements using the TOCl-AOX relationship described in the Appendix.
TOCl in the effluent from each stage of the CEoDED sequence was summed.
Eo and Eop pre-stages: O_2, 15 kg/mtp; NaOH, 20 kg/mtp; $MgSO_4$, 2.5 kg/mtp; H_2O_2 in Eop, 5 kg/mtp.
O stage: O_2, 20 kg/mtp; NaOH, 20 kg/mtp; $MgSO_4$, 2.5 kg/mtp.
D_1 stage: ClO_2, 3.0 kg/mtp

TABLE III
DELIGNIFICATION AND CEo(DN)D BLEACHING OF A WESTERN HEMLOCK KRAFT PULP

					Chemicals added, kg/mtp, OD basis				Properties				
Pre-Treatment	Kappa No.	Visc., mPa.s	C-stage Type	Kappa Factor Cl_2 alone	C-stage Cl_2	C-stage ClO_2	D_1-stage ClO_2	Total NaOH	kg/ADTBP of TOCl	kg/ADTBP of AOX	Kappa No. after CEo	Viscosity, mPa.s	ISO Brightness after D_1, %
None	27.6	26.7	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.19	52.0	2.2	9.0	34	3.8	3.7	4.6	20.2	89.7
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	29.0	11.0	9.0	32	3.0	3.0	4.7	20.9	90.0
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.06	17.4	15.4	7.0	28	2.4	2.5	3.8	21.2	89.5
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	5.8	19.8	7.0	26	2.3	1.4	5.2	21.0	89.9
Eo	21.1	25.2	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.19	39.9	1.7	6.0	45	3.3	3.3	2.7	20.1	90.6
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	22.2	8.4	6.0	38	2.5	2.5	2.6	20.3	90.1
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.06	13.3	11.8	6.0	35	2.1	2.1	2.6	21.0	90.0
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	4.4	15.3	6.0	33	1.7	0.9	4.1	21.2	89.9
Eop	18.5	24.8	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.20	35.0	1.5	6.0	45	2.7	2.6	2.4	20.0	90.8
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	19.5	7.4	6.0	38	1.8	1.8	2.5	20.3	90.3
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.06	11.7	10.4	6.0	35	1.4	1.5	2.6	20.8	90.2
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	3.[illegible]	13.3	6.0	33	0.9	0.5	3.7	21.0	90.0
O	14.6	23.6	$C_{\text{[illegible]}}+d_{\text{[illegible]}}$	0.20	27.6	1.2	6.0	37	2.3	2.2	2.0	19.2	90.9
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.11	14.4	5.8	6.0	33	1.3	1.4	2.1	19.1	90.7
			$D_{\text{[illegible]}}c_{\text{[illegible]}}$	0.07	9.2	8.2	6.0	30	1.2	1.2	2.4	19.3	90.2
			$D_{\text{[illegible]}}+c_{\text{[illegible]}}$	0.02	3.1	10.5	6.0	30	0.5	0.3	3.7	19.7	90.0

mtp = metric ton pulp (OD basis)
TOCl and AOX measurements are reported on air-dry metric ton bleached pulp basis.
AOX values were derived from TOCl measurements using the TOCl-AOX relationship described in the Appendix.
TOCl in the effluent from each stage of the CEo(DN)D sequence was summed.
Eo and Eop pre-stages: O_2, 15 kg/mtp; NaOH, 20 kg/mtp; $MgSO_4$, 2.5 kg/mtp; H_2O_2 in Eop, 5 kg/mtp.
O stage: O_2, 20 kg/mtp; NaOH, 20 kg/mtp; $MgSO_4$, 2.5 kg/mtp.
D_1 stage: ClO_2, 3.0 kg/mtp

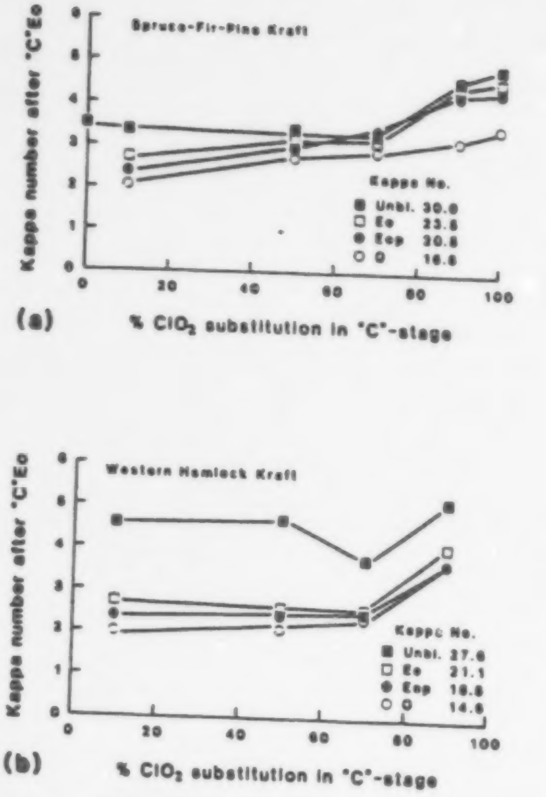


Fig. 1. Effect of chlorine dioxide in the C-stage on kappa number after CEo. The pulps tested had different kappa numbers before the C-stage as a result of Eo, Eop or O-delignification. A. Spruce-balsam fir-pine kraft pulp from eastern Canada. B. Western hemlock kraft pulp from British Columbia

(Table II). Even when preceded by an oxygen delignification stage, a high charge of chlorine dioxide in the "chlorination" stage made the pulp less responsive to chlorine dioxide bleaching in the later stages.

Others (7, 13-16) have shown that the kappa number after the first extraction stage decreases as chlorine dioxide is substituted for chlorine in the chlorination stage and then rises again as 100 percent chlorine dioxide is approached. Lower brightnesses after DED and DEDED compared to CED and CEDED have also been reported. Singh and Andrews (14) found that in order to bleach effectively with 100% ClO_2 it was necessary to use more forcing conditions in the first stage. Germgard (16) showed that the delignification rate increases considerably when chlorine is added to the chlorine dioxide. The presence of chlorine, even in small amounts, improves the efficiency of the chlorination stage.

AOX Formation in Bleach Effluents

The adsorbable organic halide (AOX) in the effluent from a "C"EoDED bleaching sequence was lower when one of the oxygen treatments was applied or when a high amount of chlorine dioxide was used in the chlorination stage. Table II and Figure 2A show the amount of AOX in the effluent of the bleached pine-spruce-fir eastern pulp; Table III and Figure 2B show the results obtained using the western hemlock pulp.

When a C_{90}+d_{10}EoDED sequence was applied to the eastern pulp brownstock, the effluent contained 5.9 kg AOX per metric tonne bleached pulp, air-dry basis (ADTBP). With up to 70% chlorine dioxide substitution in the chlorination stage, the AOX content decreased linearly to 3.9 kg/ADTBP (Figure 2A). Increasing the chlorine dioxide substitution to 90% and 100% decreased the AOX to 2.2 and 1.7 kg/ADTBP.

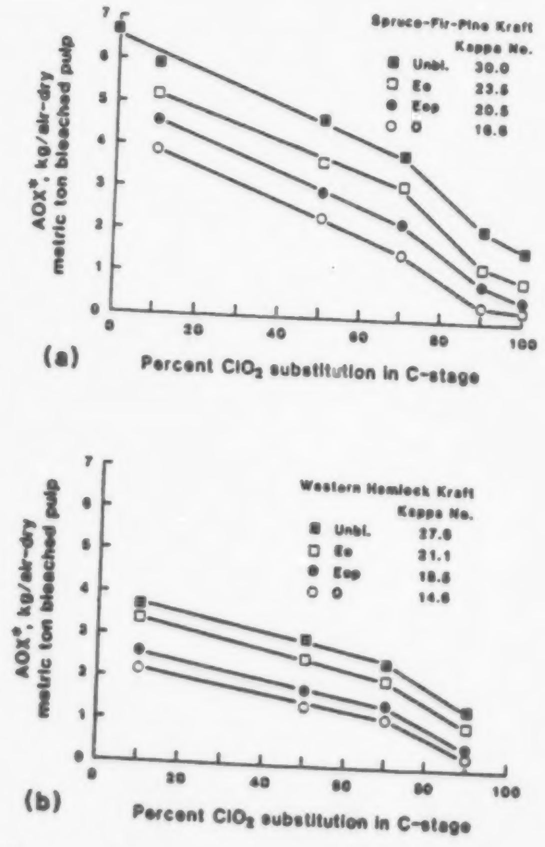


Fig. 2. Less AOX is formed in the bleach effluents when the pulps are delignified to lower kappa numbers, and when more chlorine dioxide instead of chlorine is used in the C-stage.
*The AOX values were derived from TOCl measurements using the TOCl AOX relationship described in the Appendix.

The more the pulp was delignified before the chlorination stage, the lower was the formation of AOX. After an Eo delignification stage, the effluent from the $C_{90}+d_{10}$EoDED sequence contained 5.2 kg/ADTPB. When an oxygen delignification stage preceded the sequence, AOX formation decreased to 3.9 kg/ADTBP. Oxygen delignification plus pure chlorine dioxide in the chlorination stage decreased the AOX in the effluent to 0.3 kg/ADTBP.

The results obtained upon bleaching the western hemlock pulp (Table III, Figure 2B showed similar trends to those obtained on the eastern pulp, except that the AOX values in the effluents from the bleached hemlock pulp were consistently lower. This indicates that the amount of AOX formed is dependent not only on the quantity of chlorine used in bleaching, but also on wood furnish used in pulping.

To achieve an AOX value in the bleach effluent (before any secondary treatment) not exceeding 2.5 kg/ADTBP, the eastern pulp required 90% chlorine dioxide substitution in the chlorination stage when it was applied directly to the brownstock or Eo-treated pulp. If an Eop stage preceded the sequence, a 70% chlorine dioxide substitution was adequate, whereas a 50% substitution was adequate following an O-stage.

The effluent from bleaching the western hemlock pulp contained AOX levels less than 2.5 kg/ADTBP when the sequence contained an O-delignification followed by $C_{90}+d_{10}$. The untreated brownstock needed 70% chlorine dioxide substitution in "C" to meet this requirement; on the Eo and Eop treated pulps, 50% chlorine dioxide substitution was sufficient.

It should be noted that a secondary aeration lagoon can further decrease the AOX levels in the bleach effluent by up to 50% (10); the results in this report refer to AOX values in the bleach effluent without any external treatment.

Chlorinated Phenolic Compounds in Bleach Effluents

The chlorinated phenolic compounds in the bleach effluent from the eastern pulp increased slightly as the ratio of ClO_2:Cl_2 in the C-stage was raised from 10:90 to 50:50 (Table IV, Figure 3A). Similar behaviour was noted for the western brownstock (Table V, Figure 3B).

Other researchers (15, 17) found that the quantity of chlorinated phenolic compounds in the effluent increases to a maximum at 50% chlorine dioxide substitution, above which the quantity of chlorinated phenolic compounds declines. Similarly, our results show that as the ClO_2:Cl_2 ratio was raised to 70:30, 90:10 and especially 100:0 on the eastern pulp, the chlorinated phenolic compounds in the effluent decreased considerably.

The lower chlorine requirement in the chlorination stage brought about by the Eo, Eop or O delignification stages caused substantially less formation of chlorinated phenolic compounds in the bleach effluent.

Table VI shows a comparison of the decrease in chlorinated phenolic compounds in bleach effluent as a result of pretreatment with Eo, Eop and O-stages. The comparisons were at four different chlorine dioxide substitution levels. The Eo stage decreased the kappa number of the eastern pulp by 22%, yet the chlorinated phenolics content in the effluent from the subsequent $C_{90}+d_{10}$EoDED bleaching decreased by 43% compared to the results obtained on the non-Eo delignified pulp. After Eop, which decreased the kappa number by 32%, the same bleaching sequence produced effluents with 50% less chlorinated phenolic content than that obtained from bleaching regular brownstock. The oxygen delignification stage decreased the kappa number of the eastern pulp by 45%, but the chlorinated phenolic content in the bleach effluent decreased by 54%.

TABLE IV

Effluent Load from a "C"EoDED Bleaching Sequence Preceded by Various Delignification Stages

Pulp Source: Spruce-Fir-Pine Eastern Canadian Kraft; Unbleached Kappa No: 30.0

Pre-stage	'C'-stage type	Effluent load, combined from "C"EoDED kg/ADTBP AOX	TOCl	kg/OD mp Colour	BOD	COD	Cl phenolics
None	C_{100}	6.7	6.8	221	23	64	0.121
	$C_{90}+d_{10}$	5.9	5.9	218	23	62	0.136
	$D_{50}C_{50}$	4.7	4.8	192	22	60	0.150
	$D_{70}C_{30}$	3.9	4.0	170	22	58	0.115
	$D_{90}+c_{10}$	2.2	3.2	78	20	55	0.054
	D_{100}	1.7	2.7	53	13	52	0.005
Eo	C_{100}	—	—	—	—	—	—
	$C_{90}+d_{10}$	5.2	5.4	150	19	48	0.077
	$D_{50}C_{50}$	3.7	3.8	134	19	46	0.084
	$D_{70}C_{30}$	3.2	3.2	50	19	46	0.058
	$D_{90}+c_{10}$	1.3	2.2	35	18	43	0.029
	D_{100}	1.0	1.8	19	11	38	0.009
Eop	C_{100}	—	—	—	—	—	—
	$C_{90}+d_{10}$	4.6	4.8	118	17	42	0.068
	$D_{50}C_{50}$	3.0	3.1	108	16	41	0.075
	$D_{70}C_{30}$	2.3	2.3	84	16	41	0.050
	$D_{90}+c_{10}$	0.9	1.5	29	15	34	0.020
	D_{100}	0.5	1.0	25	11	31	0.007
O	C_{100}	—	—	—	—	—	—
	$C_{90}+d_{10}$	3.9	4.1	75	16	35	0.063
	$D_{50}C_{50}$	2.4	2.5	69	16	35	0.068
	$D_{70}C_{30}$	1.6	1.5	57	15	34	0.038
	$D_{90}+c_{10}$	0.4	0.8	28	13	31	0.011
	D_{100}	0.3	0.5	16	9	28	0.005

mp = metric ton pulp (OD basis).

TOCl and AOX measurements are reported on air-dry metric ton bleached pulp basis (ADTBP).

AOX values were derived from TOCl measurements using the TOCl-AOX relationship described in the Appendix.

TABLE V

Effluent Load from a "C"Eo(DN)D Bleaching Sequence Preceded by Various Delignification Stages

Pulp Source: Western Hemlock Kraft Unbleached Kappa No: 27.6

		Effluent load, combined from "C"EoDED					
	'C'-stage	kg/ADTBP		kg/OD mtp			
Pre-stage	type	AOX	TOCl	Colour	BOD	COD	Cl phenolics
None	$C_{90} + d_{10}$	3.7	3.8	166	20	59	0.080
	$D_{50}C_{50}$	3.0	3.0	128	20	59	0.087
	$D_{70}C_{30}$	2.5	2.4	110	20	58	0.068
	$D_{90} + c_{10}$	1.4	2.3	67	18	58	0.052
Eo	$C_{90} + d_{10}$	3.3	3.3	121	14	44	0.051
	$D_{50}C_{50}$	2.5	2.5	105	14	44	0.056
	$D_{70}C_{30}$	2.1	2.1	66	14	40	0.038
	$D_{90} + c_{10}$	0.9	1.7	40	10	40	0.010
Eop	$C_{90} + d_{10}$	2.6	2.7	102	14	38	0.043
	$D_{50}C_{50}$	1.8	1.8	83	14	39	0.048
	$D_{70}C_{30}$	1.5	1.4	54	13	36	0.030
	$D_{90} + c_{10}$	0.5	0.9	33	9	32	0.005
O	$C_{90} + d_{10}$	2.2	2.3	70	13	31	0.041
	$D_{50}C_{50}$	1.4	1.3	56	12	29	0.046
	$D_{70}C_{30}$	1.2	1.2	36	11	24	0.031
	$D_{90} + c_{10}$	0.3	0.5	21	9	24	0.004

mtp = metric ton pulp (OD basis).

TOCl and AOX measurements are reported on air-dry metric ton bleached pulp basis (ADTBP).

AOX values were derived from TOCl measurements using the TOCl-AOX relationship described in the Appendix.

Thus the Eo and the Eop stages were surprisingly effective at decreasing chlorinated phenolic compounds; on both pulps they were practically as good as the oxygen stage.

With pure chlorine dioxide in the C-stage applied to the eastern pulp, the formation of chlorinated phenolic compounds was small (0.005-0.009 kg/mtp) and lowering the incoming kappa number had no detectable effect on decreasing the formation of chlorinated phenolic compounds in the effluent (Table IV).

Analysis of the individual phenolic components in the effluent from the bleached eastern pulp showed that the catechols and guaiacols together comprised 77% of the total chlorinated phenolic content when chlorine alone was used in the "C"-stage (Figure 4). As more of the chlorine was replaced by chlorine dioxide, the quantity of catechols and guaiacols decreased. When a 70:30 chlorine dioxide:chlorine ratio was used in the "C"-stage the catechol and guaiacol portion of the chlorinated phenolic compounds decreased to 36%. At 100% chlorine dioxide substitution, only 10% of the chlorinated phenolics were of the catechol and guaiacol type. Their decrease is noteworthy because they are deemed to be the most toxic of the chlorinated phenolic compounds.

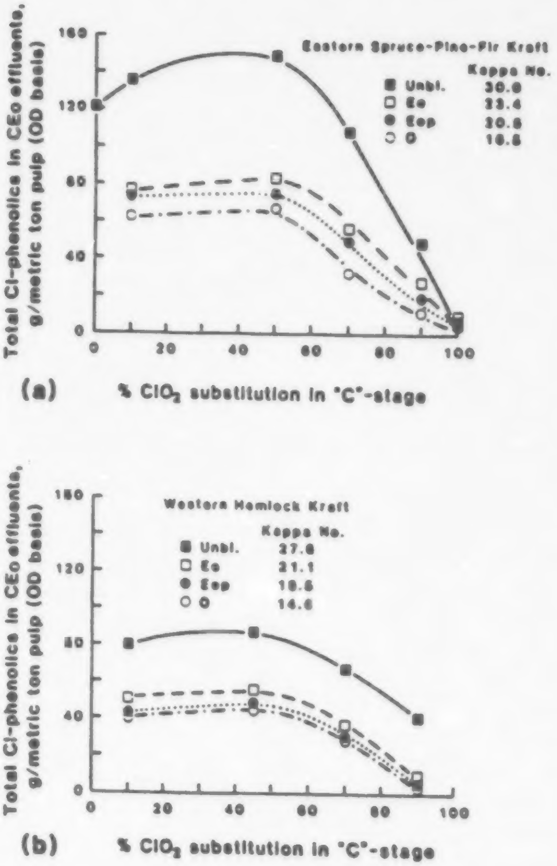


Fig. 3. The effect of chlorine dioxide substitution on the formation of chlorinated phenolic compounds during the bleaching of softwood pulps with and without various delignification treatments.

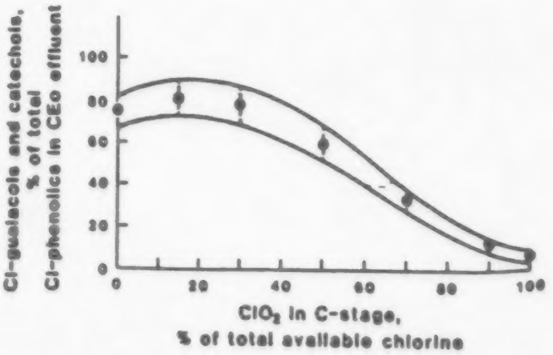


Fig. 4. The amount of chlorinated guaiacols and catechols in the total chlorinated phenolic compounds in the effluent from the C and Eo stages decreases as more of the chlorine in the C-stage is substituted with chlorine dioxide. Spruce-balsam fir-pine kraft pulp from eastern Canada

TABLE VI
THE EFFECT OF VARIOUS DELIGNIFICATION STAGES ON THE DECREASE OF CHLORINATED PHENOLIC COMPOUNDS IN BLEACH EFFLUENTS

Pulp Source	Eastern Spruce-Fir-Pine				Western Hemlock			
Delignification Stage	None	Eo	Eop	O	None	Eo	Eop	O
Kappa No.	30.0	23.4	20.5	16.5	27.6	21.1	18.5	14.6
Kappa No., % decrease compared to brownstock	NA	22	32	45	NA	24	33	47
Chlorinated phenolics in bleach effluents, % decrease compared to sequences without a delignification stage: "C" stage type in CEoDED:								
$C_{90}+d_{10}$	NA	43	50	54	NA	36	46	49
$D_{50}c_{50}$		56	50	55		36	45	47
$D_{70}c_{30}$		50	57	67		45	54	54
$D_{90}+c_{10}$		46	63	80		81	90	92

NA — Not applicable — base case.

BOD, COD, and Colour Values

The BOD, COD, and colour in the bleach effluents are shown in Tables IV and V. With the exception of the D_{100}EoDED sequence, the amount of chlorine dioxide substitution in the C-stage did not affect the BOD of the effluent. The Eo, Eop and O delignification stages caused the COD levels of the effluent to decline roughly proportional to the degree of delignification. BOD also dropped as the kappa number was reduced, but not so rapidly as COD levels. The effluent became less coloured as the chlorine dioxide substitution in the C-stage increased and as the intensity of the delignification stage increased.

Toxicity to Fish

The "C" and Eo effluents from the eastern pulps were combined in a 1:1 ratio and were tested for toxicity to rainbow trout fingerlings (Salmo gairdneri). The Cl_2:ClO_2 ratios in the C-stage varied form 90:10 to 10:90. Before combining, the C effluent was treated with sufficient sodium thiosulphate to quench residual chlorine. The mean lethal concentration (24-hour LC50 and 96-hour LC50) of each combined effluent was estimated from mortality data of serially diluted samples using the method described by Voss et al. (18).

The highest toxicity was observed on the effluent from the C_{90}+d_{10}Eo stages (Table VII). As the Cl_2:ClO_2 ratio decreased from 90:10 to 36:65, the toxicity decreased progressively. Once the Cl_2:ClO_2 ratio of 10:90 was reached, the effluent became substantially less toxic. At a 90% chlorine dioxide substitution in the D+c stage, the bleach effluent was non-toxic. The decrease in fish toxicity observed when high chlorine dioxide substitution was used in the C-stage correlates with the lower levels of chlorinated phenolic compounds in the effluent.

TABLE VII
TOXICITY OF CEo EFFLUENTS TO RAINBOW TROUT

Cl_2:ClO_2 ratio in C-stage	LC 50 Values, % 24-hour	96-hour
90:10	30	20
70:30	35	27
50:50	33	32
45:55	50	37
40:60	50	34
35:65	70	42
30:70	92	70
10:90	100	100

Pulp Furnish used: Spruce-Fir-Pine kraft.
C and Eo Effluents combined in a 1:1 ratio.
Loading density: 0.45 L/g; Ave. fish weight: 1.05 g.
Dilution water: well water

Cost Comparison

We made cost comparisons for bleaching the 2 pulps at different delignification levels and at various ClO_2 substitution levels. The comparison was based on the costs of the bleaching chemicals and steam; not included were the investment costs for new equipment for the delignification stages and the extra chlorine dioxide capacity. (The Eo and Eop delignification stages can, in some cases, be retrofitted using existing extraction stage equipment). Maintenance costs were assumed to be the same in all of the sequences.

The charges of chemicals (chlorine, chlorine dioxide, sodium hydroxide, oxygen, peroxide and magnesium sulphate) required in each sequence to reach 90+ brightness and the chemical and steam costs are listed in Table VIII and IX. In half of the sequences, the opportunity exists to use oxidized white liquor to replace some of the pure caustic. Because of the difficulty in assigning a cost to the oxidized white liquor made at a mill, the costs throughout were based on pure caustic.

TABLE VIII
COMPARING THE CHEMICAL AND STEAM COSTS WHEN APPLYING VARIOUS BLEACHING SEQUENCES TO AN EASTERN CANADIAN SPRUCE-FIR-PINE KRAFT PULP

Pretreatment	C-stage in CEoDED	Chemicals used, kg/mtp, OD basis1) Cl_2	ClO_2	NaOH	NaOH from White Liquor3)	Cost, $/mtp, OD basis Chemicals	Steam2)
None	$C_{90}+d_{10}$	39.4	17.5	37	0	50	2.2
	$D_{50}C_{50}$	33.0	27.6	33	0	52	2.2
	$D_{70}C_{30}$	19.8	32.6	30	0	52	2.2
	$D_{90}+c_{10}$	6.6	37.6	27	0	53	2.2
	D_{100}	0	40.1	26	0	54	2.2
Eo	$C_{90}+d_{10}$	46.3	12.0	45	15	45	4.5
	$D_{50}C_{50}$	25.8	19.8	39	15	45	4.5
	$D_{70}C_{30}$	15.4	23.7	35	14	45	4.5
	$D_{90}+c_{10}$	5.1	27.6	33	15	46	4.5
	D_{100}	0	29.6	33	15	46	4.5
Eop	$C_{90}+d_{10}$	40.6	10.7	45	0	48	4.5
	$D_{50}C_{50}$	22.6	18.6	39	0	49	4.5
	$D_{70}C_{30}$	13.5	22.0	39	0	49	4.5
	$D_{90}+c_{10}$	4.5	25.4	33	0	49	4.5
	D_{100}	0	27.2	33	0	50	4.5
O	$C_{90}+d_{10}$	33.0	9.4	38	15	35	4.5
	$D_{50}C_{50}$	18.3	15.9	33	15	37	4.5
	$D_{70}C_{30}$	11.0	19.7	30	15	38	4.5
	$D_{90}+c_{10}$	3.6	22.5	29	15	38	4.5
	D_{100}	0	23.8	28	15	38	4.5

1) Eo and Eop stages: O_2, 5 kg/mtp, $MgSO_4$, 2.5 kg/mtp, H_2O_2 in Eop, 5 kg/mtp
O stage: O_2, 20 kg/mtp, $MgSO_4$, 2.5 kg/mtp
2) Total temperature increase in bleach plant: no pretreatment, 20°C; Eo, Eop and O pretreatment, 40°C
Chemical costs were assumed as follows: chlorine, $0.30/kg; chlorine dioxide, $1.10/kg; oxygen, $0.12/kg; caustic, $0.325/kg; hydrogen peroxide, $1.30/kg; $MgSO_4$, $0.57/kg
3) This value is given here for information purposes. It is already included in the "NaOH" column

TABLE IX
COMPARING THE CHEMICAL AND STEAM COSTS WHEN APPLYING VARIOUS BLEACHING SEQUENCES TO A WESTERN HEMLOCK KRAFT PULP

Pretreatment	C-stage in CEo(DN)D	Chemicals used, kg/mtp, OD basis1) Cl_2	ClO_2	NaOH	NaOH from White Liquor3)	Cost, $/mtp, OD basis Chemicals	Steam2)
None	$C_{90}+d_{10}$	32.0	14.2	33.5	0	43	2.2
	$D_{50}C_{50}$	29.0	23.0	31.5	0	45	2.2
	$D_{70}C_{30}$	17.4	25.4	28.0	0	43	2.2
	$D_{90}+c_{10}$	3.8	29.8	29.0	0	44	2.2
Eo	$C_{90}+d_{10}$	39.9	10.7	45.0	15	41	4.5
	$D_{50}C_{50}$	22.2	17.4	38.0	15	41	4.5
	$D_{70}C_{30}$	13.3	20.8	35.0	15	41	4.5
	$D_{90}+c_{10}$	4.4	27.6	33.0	15	42	4.5
Eop	$C_{90}+d_{10}$	35.0	10.5	45.0	0	46	4.5
	$D_{50}C_{50}$	19.5	16.4	38.0	0	46	4.5
	$D_{70}C_{30}$	11.7	19.4	35.0	0	46	4.5
	$D_{90}+c_{10}$	3.9	22.3	33.0	0	46	4.5
O	$C_{90}+d_{10}$	27.6	10.2	37.0	15	35	4.5
	$D_{50}C_{50}$	14.4	14.8	33.0	15	34	4.5
	$D_{70}C_{30}$	9.2	17.2	30.0	15	34	4.5
	$D_{90}+c_{10}$	3.1	19.5	30.0	15	35	4.5

1), 2) and 3) see Table VIII

The cost of the steam needed to raise the temperature of the pulp in the initial bleaching stages, up to and including the Eo stage, are included in the Tables. The steam cost for the last three stages - i.e. DED or (DN)D - has been omitted, because it is common to all sequences and therefore does not affect the calculated ratios. Temperatures are noted in Table I for the unbleached pulp entering the process and for the stages up to and including the Eo stage. The total of the required temperature rises in the bleach plant is 40°C for the oxygen pretreated pulps and 20°C when bleaching without pretreatment. Using $6.60 per metric ton of steam, we calculated a cost of $0.112 to raise the temperature of one oven-dry ton of pulp at 10% consistency by one degree Celsius.

The chemical cost of each sequence is shown in Figure 5. Replacing the chlorine by chlorine dioxide does not change the bleaching costs appreciably. Addition of an Eo delignification stage decreases the chemical costs by $2-6 per ton pulp. (Note that amortization of capital investment is not included). In terms of chemi-cal costs, an oxygen delignification stage applied to an eastern pulp cuts the chemical cost of a $C_{90}+d_{10}$EoDED sequence from $50 to $35/mtp. Bleaching a western pulp with an O$C_{90}+d_{10}$Eo(DN)D sequence was also estimated to cost $35/mtp, $8 less than the companion $C_{90}+d_{10}$Eo(DN)D sequence. It should be noted that these are relative costs, nd that each mill site should have an indepen-dent economic analysis using local cost figures.

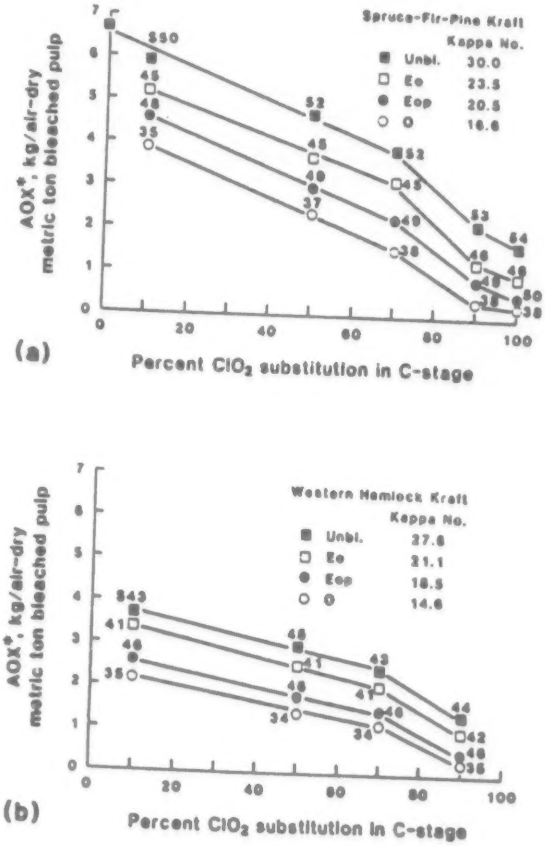


Fig. 5. The bleaching chemical costs are calculated at the various chlorine dioxide substitution levels and delignification treatments. The numbers marked by each data point indicate (in Canadian dollars) the approximate expenditures required to reach a specific AOX level.

CONCLUSIONS

An Eo stage applied to the brownstock decreased the kappa number of an eastern Canadian spruce balsam fir-pine or a western hemlock kraft pulp by approximately 23%. By using peroxide in this stage (Eop stage) the kappa number of the brownstock decreased by 32%. The O-stage was best at delignifying the pulp (46% delignification).

The AOX in the effluent from the "C"EoDED (eastern pulp) or the "C"Eo(DN)D (western pulp) decreased as more of the chlorine in the "C"stage was substituted by an equivalent amount of chlorine dioxide. The more the pulp was delignified before the chlorination stage, the lower the formation of AOX. To achieve a bleach effluent AOX value of less than 2.5 kg/ADTBP (before any secondary treatment), an eastern pulp required 90% chlorine dioxide substitution in the "C"-stage.

The same result was achieved with only 70% ClO_2 substitution if the pulp was pretreated via Eop and 50% substitution if an O-stage was used. The bleach effluents from the western hemlock pulp contained lower AOX levels than did those from the eastern pulp at comparable delignification and chlorine dioxide substitution levels. An AOX value of less than 2.5 kg/ADTBP in the bleach effluent (before any secondary treatment) was obtained when 70% chlorine dioxide substitution was used in a "C" stage applied to brownstock. With Eo or Eop before the "C" stage, this AOX level was reached using 50% chlorine dioxide substitution. Only 10% chlorine dioxide substitution in C" was necessary when an O-stage was used in the sequence. The results of this work indicate that the amount of AOX formed is dependent not only on quantity of chlorine used but also on the wood furnish used in pulping.

Raising the chlorine dioxide substitution to 70% and especially to 90% in the "C"-stage produced less chlorinated phenolic compounds in the bleach effluents. The effluents were also less coloured and less toxic to fish. The BOD and COD in the effluent decreased only with very high chlorine dioxide substitution levels.

While a high amount of chlorine dioxide in the chlorination stage was best for lowering the AOX content in the effluent, it made the eastern pulp less responsive to chlorine dioxide bleaching in later stages.

In terms of chemical costs, an oxygen delignification stage cuts the cost of a "C"EoDED sequence at various chlorine dioxide substitution levels applied to an eastern pulp by approximately 30%, and of a "C"Eo(DN)D sequence applied to a western hemlock pulp by about 20%. Eo and Eop delignification stages had a smaller effect on the chemical costs.

APPENDIX

Relationship of TOCl and AOX

During the course of bleaching work at Paprican, we have assembled TOCl and AOX measurements on the same bleach effluents. The TOCl was measured using the titration method developed by Rapson et al. (7) for chloride ion and the results are different from those obtained by researchers in Scandinavia who used another method of TOCl analysis (6). Because of the current preference for AOX values, we have decided to convert the TOCl measurements to AOX.

Figures 6 and 7 show the correlation we have obtained between our AOX and TOCl data over the past 18 months. It was apparent that when the chlorination stage was done at substitution levels from $C_{100}d_0$ to $D_{70}C_{30}$, the AOX and TOCl formed a linear relationship (Figure 6) with the TOCl values being slightly higher than the AOX values. At chlorine dioxide substitution levels as high as 90 and 100%, a different relationship was found (Fig. 7) where the TOCl values were as much as double the AOX values. The formulae indicated in the graphs were used to convert the measured TOCl values in Tables II and III to AOX values used in Figures 2 and 5.

Please note that the formulae we developed to convert TOCl to AOX values apply to the TOCl method described by Rapson et al. (7).

ACKNOWLEDGEMENTS

The authors would like to sincerely thank the following: Mr. Tibor Kovacs and his staff for the fish toxicity determinations; the staff of the Chemical and Physical Analysis Sections for the measurements of the pulp and effluent properties; Mr. M.F. Davy for the cost analysis; Dr. Bruce Fleming for valuable comments in reviewing the manuscript.

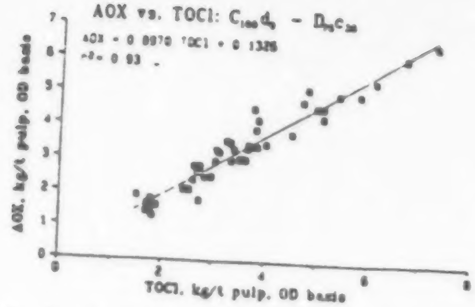


Fig. 6. Correlation of AOX and TOCl values measured on the same bleach effluents where the C-stage consisted of chlorine dioxide substitutions from 0 to 70%.

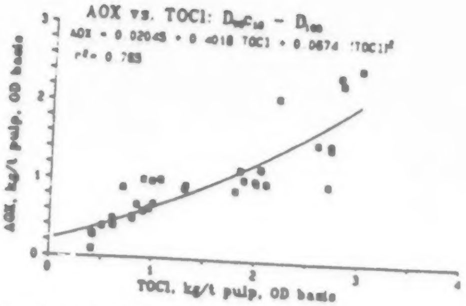


Fig. 7. Correlation of AOX and TOCl values measured on the same bleach effluents where the C-stage consisted of chlorine dioxide substitutions of 90 and 100%.

REFERENCES

1. HEIMBURGER, S.A., BLEVINS, DS., BOSTWICK, J.H., and DONNINI, G.P., "Kraft Mill Bleach Effluents: Recent Developments Aimed at Decreasing their Environmental Impact, Part 1". Tappi J. 71(9):51 60 (1988).

2. HEIMBURGER, S.A., BLEVINS, D.S., BOSTWICK, J.H., and DONNINI, G.P., "Kraft Mill Bleach Effluents: Recent Developments Aimed at Decreasing their Environmental Impact, Part 2." Tappi J. 71(10):69-78 (1988).

3. GALL, R.J. and THOMPSON, F.H., "The Anti-Pollution Sequence - A New Route to Reduced Pollutants in Bleach Plant Effluent". Tappi 56(11):72-76 (1973).

4. ODENDAHL, S.M., WEISHAR, K.M. and REEVE, D.W., "Chlorinated Organic Matter in Bleached Chemical Pulp Production: Part II. Measurement Techniques for Effluents". In Proceedings of the 75th CPPA Technical Section Annual Meeting, Jan 31-Feb 3, 1989. P. A293-A302.

5. REEVE, D.W. and EARL, P.F., "Chlorinated Organic Matter in Bleached Chemical Pulp Production: Part II. Environmental Impact and Regulation of Effluents. In Proceedings of the 75th CPPA Technical Section Annual Meeting, Jan 31-Feb 3, 1989. P. B147-B152.

6. AXEGARD, P. "Improvement of Bleach Plant Effluent by Cutting Back on Cl_2". In Proceedings of the 1988 TAPPI-CPPA International Pulp Bleaching Conference, Orlando, Florida. June 2-5, 1989. P. 69-76.

7. RAPSON, W.H. and ANDERSON, C.B., "Mixtures of Chlorine and Chlorine Dioxide in the Chlorination Stage of Pulp Bleaching". Pulp Paper Mag. Can. 67(1):T47 (1966).

8. VAN LIEROP, B., LIEBERGOTT, N., TEODORESCU, G., KUBES, G.J., "Oxygen in Bleaching Sequences - An Overview". Pulp Paper Can. 87(5):T193 (1986).

9. SCROGGINS, R.P., "In-plant Toxicity Balances for a Bleached Kraft Pulp Mill". Pulp Paper Can. 87(9):T344-T348 (1986).

10. COOK, C.R., "Organochlorine Discharges from a Bleached Kraft Pulp Mill with Oxygen Delignification and Secondary Treatment System". In Proceedings of the CPPA Environment Conference, Vancouver, B.C. October 25-27, 1988. p. 37.

11. VAN LIEROP, B., LIEBERGOTT, N., TEODORESCU, G., KUBES, G.J., Using Oxygen in the First Extraction Stage of a Bleaching Sequence. J. Pulp Paper Sci. 12(5):J133-140 (1986).

12. VOSS, R.H., WEARING, J.T. and WONG, A., "A Novel Gas Chromatographic Method for the Analysis of Chlorinated Phenolics in Pulp Mill Effluents." In Advances in the Identification and Analysis of Organic Pollutants in Water (Edited by Keith L. H.), Vol. 2, 1059-1095. Ann Arbor Science, Ann Arbor, MI. (1981).

13. RAPSON, W.H. and ANDERSON, C.B., "Kraft Pulp Bleaching with Chlorine and Chlorine Dioxide". The effect of pH on the chlorination stage. Tappi 61(10):97-99 (1978).

14. SINGH, R.P. and ANDREWS, D.H., "The Bleaching of Kraft Pulp: Modifications in the Sequence CEDED". Pulp Paper Mag. Can. 66(12):T628-T638 (1965).

15. AXEGARD, P., "Effect of ClO_2 Substitution on Bleaching Efficiency and the Formation of Organically Bound Chlorine - Part II". J. Pulp Paper Sci. 12(3):J67-J72 (1986).

16. GERMGARD, U., "Technical Consequences of New Knowledge on Pre-bleaching with a High Fraction of Chlorine Dioxide". In Proceedings of the TAPPI/CPPA 1982 International Pulp Bleaching Conference, Portland Oregon (1982) p 185-194.

17. VOSS, R.H., WEARING, J.T., and WONG, A., "Effect of Softwood Chlorination Conditions on the Formation of Toxic Chlorinated Compounds. Pulp Paper Can. 82(2):T65-71 (1981).

18. VOSS, R.H., WEARING, J.W. and WONG, A., "Effect of Pulp Chlorination Conditions on the Formation of Toxic Chlorinated Compounds". CPAR report No. 828 (1979).

APPENDIX D

Preliminary Archaeology Assessment

ARCHAEOLOGICAL IMPACT ASSESSMENT
PROPOSED EXPANSION PROJECT
CELGAR PULP MILL, CASTLEGAR

Prepared for:

CELGAR PULP COMPANY
Castlegar, B.C.

Prepared by:

ARCAS CONSULTING ARCHAEOLOGISTS LTD.
203 - 3030 Lincoln Avenue,
Coquitlam, B.C. V3B 6B4

March 1990

ARCHAEOLOGICAL IMPACT ASSESSMENT
PROPOSED EXPANSION PROJECT
CELGAR PULP MILL, CASTLEGAR

PROJECT DIRECTOR	Arnoud H. Stryd, Ph.D.*
RESEARCH ARCHAEOLOGIST	Richard Brolly, B.A.
REPORT AUTHORS	Arnoud H. Stryd Richard Brolly
REPORT DRAFTING BY	Richard Brolly
REPORT PHOTOGRAPHS BY	Richard Brolly

---

* all personnel are from Arcas Consulting Archeologists Ltd.

SUMMARY

In March of 1990 Arcas Consulting Archeologists Ltd undertook, on behalf of Celgar Pulp Company, an archaeological impact assessment for a proposed expansion of the Celgar pulp mill near the town of Castlegar in southeastern British Columbia. This report presents the results of that assessment.

Proposed expansion of the Celgar pulp mill at Castlegar will involve a number of land-altering activities on the property of the existing pulp mill and at a proposed effluent treatment plant in a former borrow pit about 2 km from the mill.

Archaeological sites are locations with remains (artifacts, butchered animal remains, human skeletons, etc.) produced by human activities in the past. The objectives of the impact assessment were (1) to identify and evaluate archaeological sites within the development property; (2) to identify and assess all impacts on archaeological sites which might result from the proposed pulp mill expansion; and (3) to recommend viable alternatives for managing unavoidable adverse impacts by the proposed development on archaeological sites. The assessment was conducted in accordance with British Columbia Archaeological Impact Assessment Guidelines (1989) issued by the Archaeology and Outdoor Recreation Branch (AORB) of the Ministry of Municipal Affairs, Recreation and Culture.

The assessment consisted of background research, an evaluation of the archaeological site potential of the development property, and a field survey (reconnaissance) of the development property for archaeological sites.

The assessment of archaeological site potential, based on aerial photograph interpretation and in-field inspection, concluded that all of the existing pulp mill area as well as the borrow pit at the proposed effluent treatment plant had no potential for intact archaeological sites. The site potential assessment did reveal, however, that some excavations at the treatment plant were planned for an area outside the borrow pit which appeared to have at least some potential for surficial or buried archaeological sites. This area, which consisted of the back remnant of a fluvial terrace, was the focus of the field survey.

No archaeological sites were identified during the field survey. Snow cover prevented inspection of the surface in this area, and frozen ground made testing impossible. Although of possible paleoecological rather than archaeological interest, a layer of volcanic tephra (ash), possibly 6700 years in age, and a probable palaeosol (an ancient natural soil formation preserved in situ) of similar age were identified in the side of the borrow pit. No archaeological materials were seen in association with these layers.

The assessment indicated that the proposed Celgar pulp mill expansion will not impact any known archaeological sites. The likelihood that the project will impact unidentified intact archaeological sites is

nonexistent at the mill site and in the borrow pit at the proposed treatment plant. The potential for unidentified intact archaeological sites in the area outside the borrow pit in the terrace remnant is considered to be low. However, although the potential for unidentified intact archaeological sites in the terrace remnant is considered to be low, any site in association with the volcanic ash or the possible palaeosol would be of very high scientific significance because of its antiquity.

Four recommendations are made regarding further archaeological work for the Celgar expansion project:

> (1) That no further archaeological assessment be undertaken for the mill area, pipeline route, and borrow pit portion of the proposed effluent treatment plant because of the nil archaeological site potential of these areas.
>
> (2) That no further archaeological assessment be undertaken for that part of the terrace remnant which will be impacted by excavations for the proposed effluent treatment plant because of the low archaeological site potential of this area.
>
> (3) That excavation of the terrace remnant for the proposed effluent treatment plant be monitored by a qualified archaeologist.
>
> (4) That the excavation contractor be informed that the excavation of the terrace remnant will be monitored for archaeological remains, and that the excavation could be delayed or halted if significant archaeological deposits are encountered.

ACKNOWLEDGEMENTS

Arcas Consulting Archeologists Ltd would like to thank the Celgar Pulp Company for the opportunity to undertake this study. The assistance of Mr. R. C. Wigen of Celgar Pulp Company is gratefully acknowledged. The research was aided by Mr. Steven Acheson of the Archaeology and Outdoor Recreation Branch, who provided us with the relevant B.C. Archaeological Site Inventory forms, and by several individuals who discussed with us the archaeology, geology, and ethnography of the area: Lesley Anderton (Selkirk College, Castlegar), James Baker (Okanagan College, Kelowna), Randy Bouchard (B.C. Indian Language Project, Victoria), and Wayne Choquette (Yahk, B.C.).

Although a number of people contributed to this study, Arcas Consulting Archeologists Ltd is solely responsible for the content of this report, including any errors, omissions, or other shortcomings. The professional opinions expressed in this report are those of the authors.

TABLE OF CONTENTS

Page

SUMMARY iii

ACKNOWLEDGEMENTS v

LIST OF FIGURES vii

1.0. INTRODUCTION 1

  1.1. THE DEVELOPMENT PROJECT 1

  1.2. THE ARCHAEOLOGICAL IMPACT ASSESSMENT AND REVIEW PROCESS.. 5

  1.3. SCOPE AND OBJECTIVES 6

  1.4. SCHEDULE AND PERSONNEL 6

2.0. ARCHAEOLOGICAL, ETHNOGRAPHIC, AND HISTORICAL BACKGROUND 7

3.0. METHODOLOGY 12

  3.1. ASSESSMENT PLAN 12

  3.2. ASSESSMENT METHODS 13

4.0. RESULTS 16

  4.1. ARCHAEOLOGICAL SITE POTENTIAL ASSESSMENT 16

  4.2. SURVEY RESULTS 18

5.0. FURTHER WORK REQUIREMENTS 21

REFERENCES CITED 23

LIST OF FIGURES

Page

1. Location of Celgar pulp mill expansion project 2
2. Proposed effluent treatment plant 3
3. View east towards Celgar mill from opposite treatment plant 4
4. Proposed effluent treatment plant location 4
5. Quadrats surveyed by Baker in vicinity of development project .. 9
6. Location of terrace remnant and volcanic tephra exposure 17
7. Volcanic tephra and possible palaeosol in edge of borrow pit ... 19

1.0. INTRODUCTION

In March of 1990 Arcas Consulting Archeologists Ltd undertook, on behalf of the Celgar Pulp Company, an archaeological impact assessment for a proposed expansion of the Celgar pulp mill near the town of Castlegar in southeastern British Columbia. This report presents the results of that assessment.

1.1. THE DEVELOPMENT PROJECT

The Celgar Pulp Company is planning to expand its bleached kraft pulp mill at Castlegar, B.C. The mill is located on the right (south) bank of the Columbia River immediately east of the Westar sawmill and about 4.5 km west of the post office in Castlegar (Figure 1). The project will include the following land-altering activities: filling of some of the foreshore area; site preparation for new buildings; reworking of the site storm drainage system; additions to the water distribution system; reconstruction of some roads and the parking area; rerouting of process sewers, and modification to existing sanitary sewer system; construction of a new administrative building; modifications to the existing office building and repair shops; and construction of an external effluent treatment plant. The effluent treatment plant will include primary and secondary clarifiers, an aeration lagoon, a cooling pond, a spill pond, a circa 200 m-long access road, and several small ancillary structures (Figures 2 and 3).

Land-altering activities will take place at the Celgar mill site on existing mill property, and at the effluent treatment plant to be located in a former borrow pit on the south bank of the Columbia River about 2 km west of the pulp mill (Figures 3 and 4). The plant will occupy circa 12 ha immediately downstream from the Hugh Keenleyside Dam between the CP Rail grade and the Keenleyside Dam Road. A pipeline will deliver effluent from the Celgar mill to the treatment plant, and treated effluent from the treatment plant to the mill. The pipeline will parallel the railway grade, within the CP Rail right-of-way on its landward side.

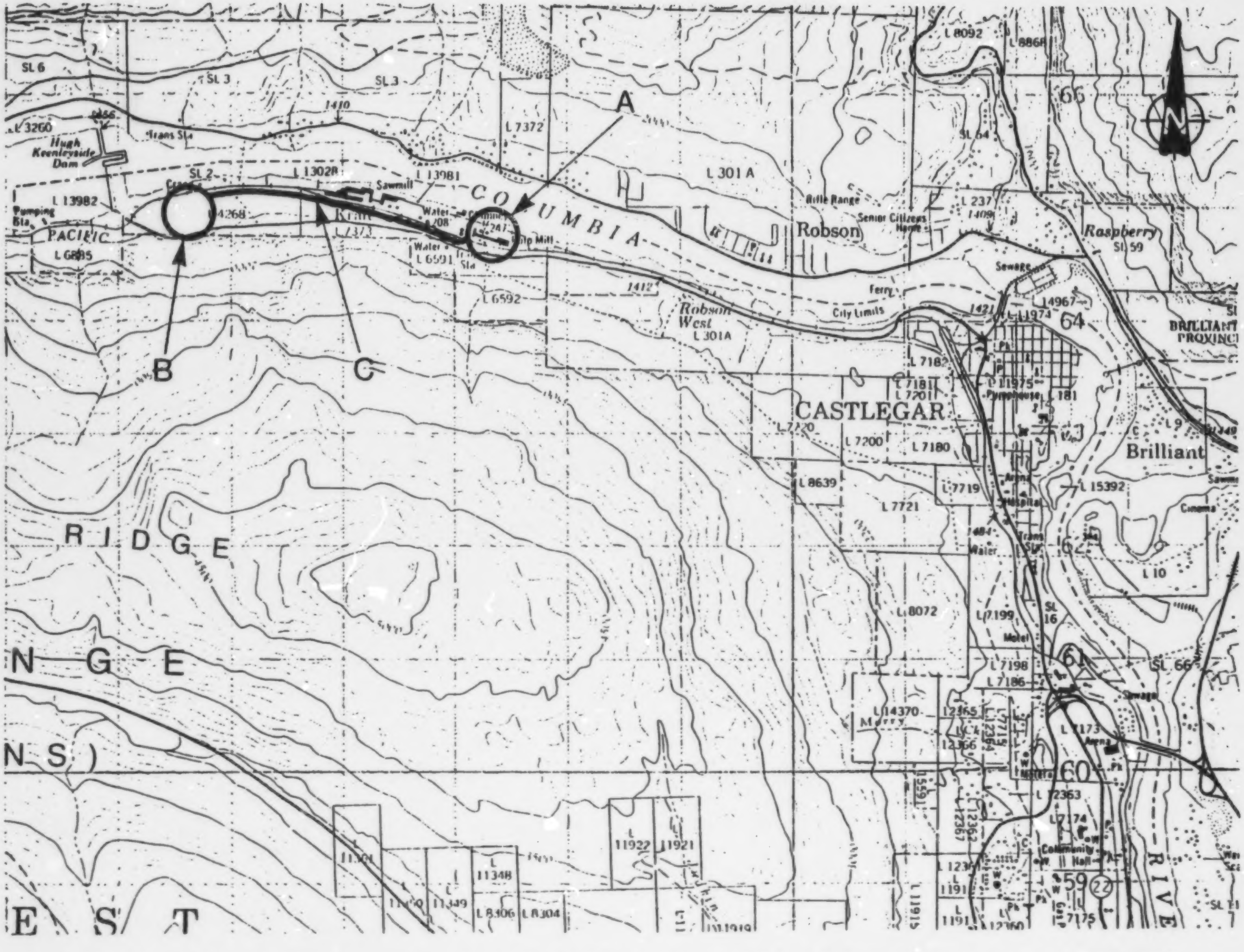

A
B
C
COLUMBIA
CASTLEGAR
Robson
Robson West
Brilliant
Raspberry
Hugh Keenleyside Dam
RIDGE
N G E
N S)
E S T
RIVE
N

Figure 1. Location of development project (1:50,000). A = existing Celgar pulp mill; B = proposed effluent treatment plant site; C = proposed pipeline.

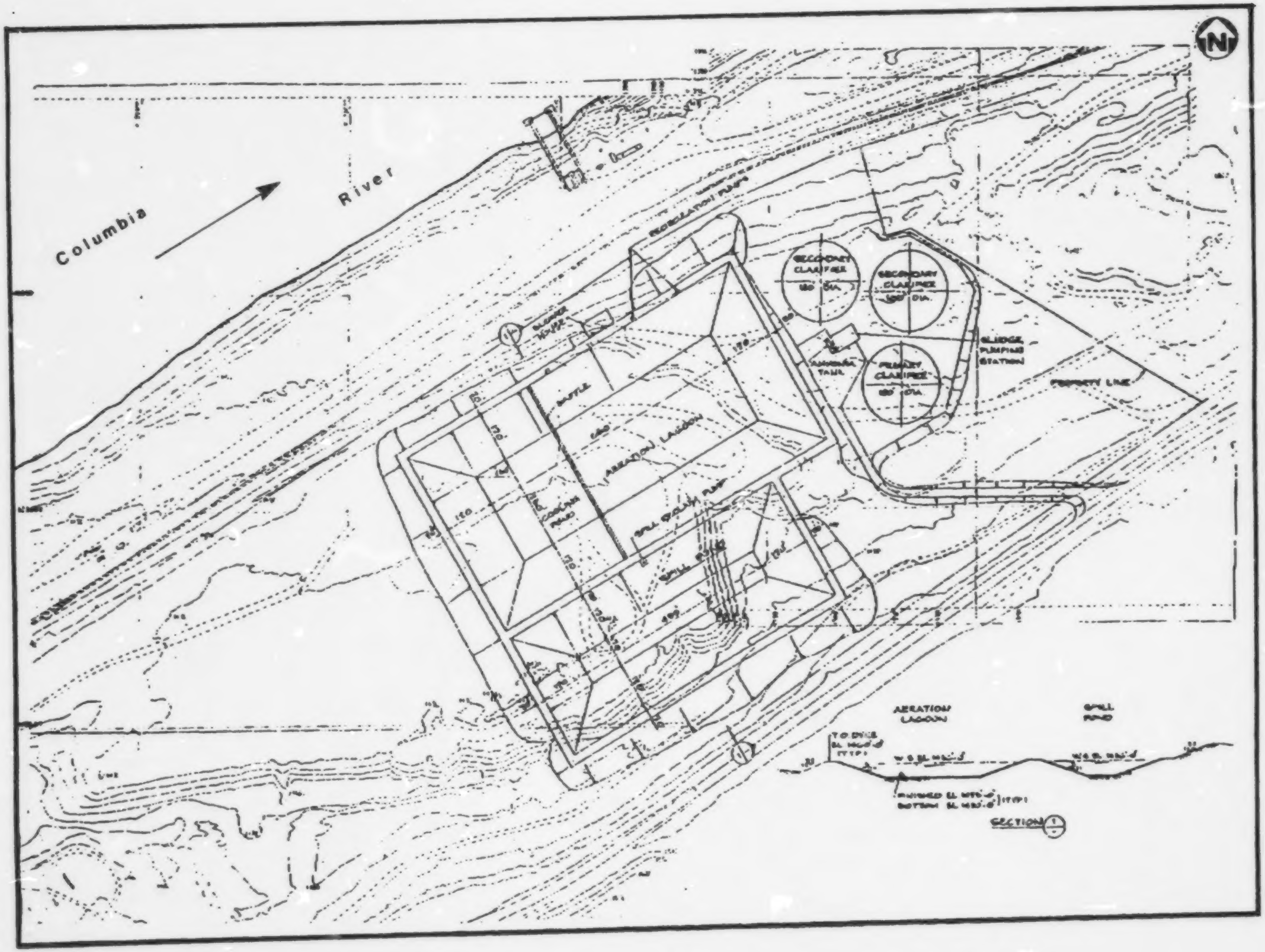

N
Columbia River
SECONDARY CLARIFIER 150' DIA.
SECONDARY CLARIFIER 150' DIA.
PRIMARY CLARIFIER 150' DIA.
AMMONIA TANK
SLUDGE PUMPING STATION
PROPERTY LINE
BAFFLE
AERATION LAGOON
COOLING POND
SPILL POND
170
AERATION LAGOON
SPILL POND
SECTION

Figure 2. Proposed effluent treatment plant (circa 1:3600).

Figure 3. View east towards Celgar mill from opposite treatment plant location.

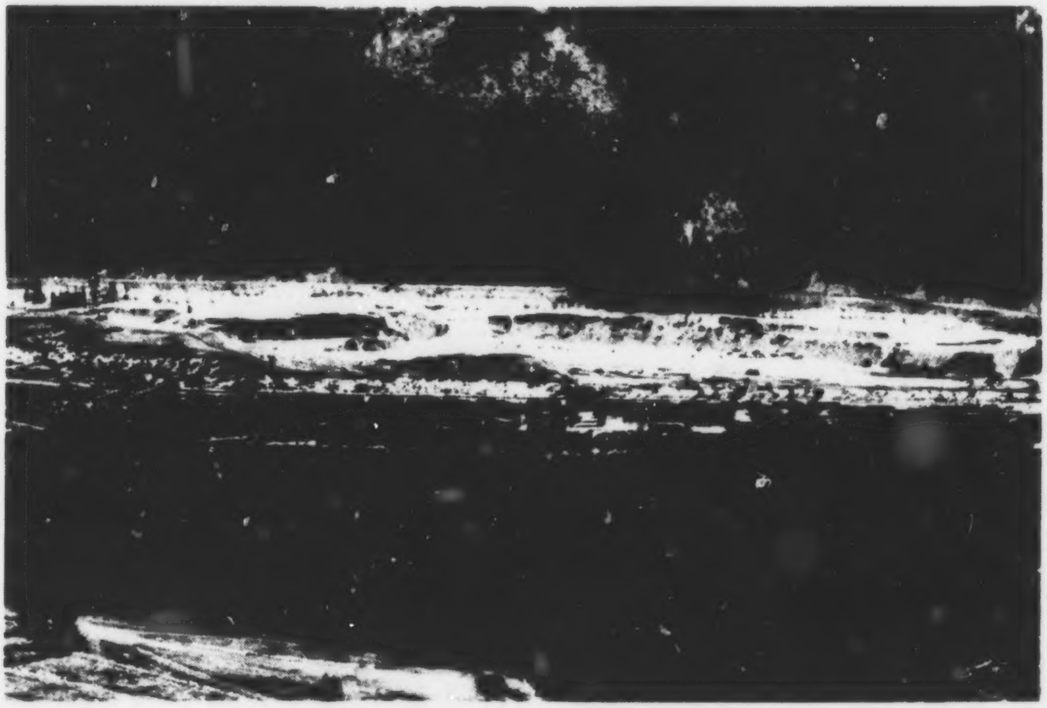


Figure 4. Proposed effluent treatment plant location, looking south.

1.2. THE ARCHAEOLOGICAL IMPACT ASSESSMENT AND REVIEW PROCESS

Archaeological sites are locations with remains (artifacts, butchered animal remains, human skeletons, food storage pits, etc.) produced by cultural (human) activities in the past. For the purposes of this study, archaeological sites are of two basic kinds: prehistoric and historic. Prehistoric sites are sites which contain artifacts and/or structural features of only aboriginal (Indian) manufacture, and these sites can only be investigated by archaeological methods (primarily excavation); historic sites, on the other hand, contain artifacts and/or structural features of non-aboriginal design or manufacture, and these can be studied not only by archaeological methods, but also by reference to written records such as diaries, government documents, newspapers, etc. In British Columbia, prehistoric archaeological sites are associated with aboriginal people and predate the arrival of the Europeans in the late 18th and early 19th centuries, whereas historic archaeological sites are associated with both aboriginal and non-aboriginal peoples (Europeans, Asians, etc.) and postdate the arrival of the Europeans.

The Archaeology and Outdoor Recreation Branch (AORB) of the B.C. Ministry of Municipal Affairs, Recreation and Culture has established an Archaeological Impact Assessment and Review Process (AIARP) for assisting industry in evaluating and mitigating the impact of proposed developments on archaeological sites. Written guidelines for the AIARP can be found in a document entitled *British Columbia Archaeological Impact Assessment Guidelines* (1989) issued by the AORB. There are usually three stages to the AIARP: overview, impact assessment, and impact management. The **overview** is intended "to identify and assess archaeological resource potential or sensitivity within a proposed study area" (AORB 1989:8), whereas the **impact assessment** is concerned with (a) the identification and evaluation of archaeological resources within a proposed development area, (b) the assessment of all impacts by the development on archaeological sites, and (c) the development of recommendations for the management of unavoidable adverse impacts on archaeological sites (AORB 1989:10). Lastly, **impact management** consists of the implementation of mitigation, monitoring, surveillance, and emergency measures in situations of unavoidable conflict between archaeological sites and a development (AORB 1989:14).

The present study is an archaeological impact assessment as defined in the AORB guidelines. Background research typical of an archaeological overview is part of the present study.

1.3. SCOPE AND OBJECTIVES

The present study is an archaeological impact assessment as defined in the AORB guidelines (see above). The guidelines (1989:10) list three main objectives for an archaeological impact assessment. These were adopted as the objectives of this assessment, as follows:

1. *To identify and evaluate archaeological sites within the development property;*

2. *To identify and assess all impacts on archaeological sites which might result from the proposed development; and*

3. *To recommend viable alternatives for managing unavoidable adverse impacts by the proposed development on archaeological sites.*

1.4. SCHEDULE AND PERSONNEL

The assessment, consisting of background research, field work, and report preparation, took place between March 1 and 15, 1990. The assessment was under the overall direction of Dr. Arnoud Stryd, senior archaeologist with Arcas Consulting Archeologists Ltd. The field work was carried out by Richard Brolly, research archaeologist with Arcas Consulting Archeologists Ltd, on March 2, 1990. Arnoud Stryd and Richard Brolly undertook the background research and wrote this report. The maps and photographs in the report are the work of Richard Brolly.

2.0. ARCHAEOLOGICAL, ETHNOGRAPHIC, AND HISTORICAL BACKGROUND

At the time of contact with Europeans early in the 19th century, the Columbia River valley in the vicinity of Castlegar was inhabited by the Lakes Indians (Bouchard and Kennedy 1985). They spoke a dialect of Okanagan-Colville, a language belonging to the Interior Salish branch of the Salishan language family. Although the Lakes Indians are mentioned in various historical documents (e.g., Work 1830; Cox 1861; McTavish 1856), they have received only limited ethnographic attention. The Lakes people are briefly mentioned by Dawson (1892) and Teit (1909), and Teit (1930) includes a brief discussion of these people in his description of the Okanagan Indians. Ray (1939) and Elmendorf (1935-36) made later ethnographic observations, and more recently, Bouchard and Kennedy (1985) have prepared an ethnography and history of the Lakes Indians.

The Lakes people were hunters, gatherers, and fishermen who lived, from early spring to late autumn, a nomadic existence in small family groups followed by winter residency in villages in the major river valleys. In the latter part of the 19th century the Lakes Indians lived in the winter in rectangular lodges built of pole frames covered with reed mats, but before that had lived during the winter in circular, semi-subterranean, earth-covered lodges known as pithouses (Ray 1939; Teit 1930). The annual cycle of subsistence activities and settlement locations was dictated primarily by the seasonal availability and abundance of food resources. Descriptions of traditional Lakes Indian culture can be found in the above sources.

Traditionally, the Lakes people wintered in the Arrow Lakes areas (Bouchard and Kennedy 1985:15), spending part of the rest of the year along the Columbia River in what is now Washington State. However, starting the 1830s, the Lakes Indians began to winter near Fort Colville in Washington State, and by the 1870s many Lakes people lived year round along the Columbia River in Washington State. By the early 1880s, most Lakes Indians lived on the Colville Indian Reservation in Washington State (Bouchard and Kennedy 1985:15-28).

No prehistoric or historic archaeological sites have ever been reported from the development property. Archaeological research along the Arrow Lakes and in the Columbia River valley near Castlegar began in 1961, and has been sporadic since then. In 1961, Harrison surveyed the pondage of the proposed Hugh Keenleyside dam, as well as selected areas downstream of the proposed dam site, locating 77 archaeological sites (Harrison 1961a, 1961b). Four sites were located on the north bank of the Columbia River west of Castlegar opposite the Celgar mill, but Harrison's field notes make no mention of an inspection of the south bank in the vicinity of the Celgar mill. The sites on the north bank include one housepit village (registration number DiQk 1), two camps (DiQk 5 and 6), and a small, buried pit (?) exposed in the side of a borrow pit (DiQk 2). All appear to be of prehistoric age.

Archaeological excavations were subsequently undertaken at several sites, mainly pithouse villages, in the proposed pondage by Sendey in 1966 (Mitchell 1967) and by Turnbull in 1967-68 (Turnbull 1971, 1977). Turnbull (1977) proposed a 3300 year-long archaeological sequence for the Arrow Lakes area. In 1977, Mohs undertook a post-inundation archaeological survey of the Arrow Lakes (Mohs 1977), locating 37 new sites. As far as can be determined, neither Turnbull nor Mohs examined the area around the Celgar mill.

Brief archaeological surveys were conducted along the Columbia River near Castlegar in 1973 by Robinson and St. Pierre (1973), and in 1977 by Choquette (1977). A number of previously unidentified sites were located during these surveys, but the area around the Celgar mill was not visited by Choquette (pers. comm., March 15, 1990), and appears not to have been visited by Robinson and St. Pierre.

In 1980-81, Baker undertook an archaeological survey of the proposed Murphy Creek Dam pondage along the Columbia River near Castlegar (Baker 1981). Baker's survey is of importance to the present study because he examined the south bank of the river at and around the Celgar mill. Baker examined a number of randomly selected 1 x 1 km quadrats [archaeological survey areas], and three of these quadrats (identified as quadrats 15BW, 16BW, and 17BW on Figure 5) were located in the vicinity

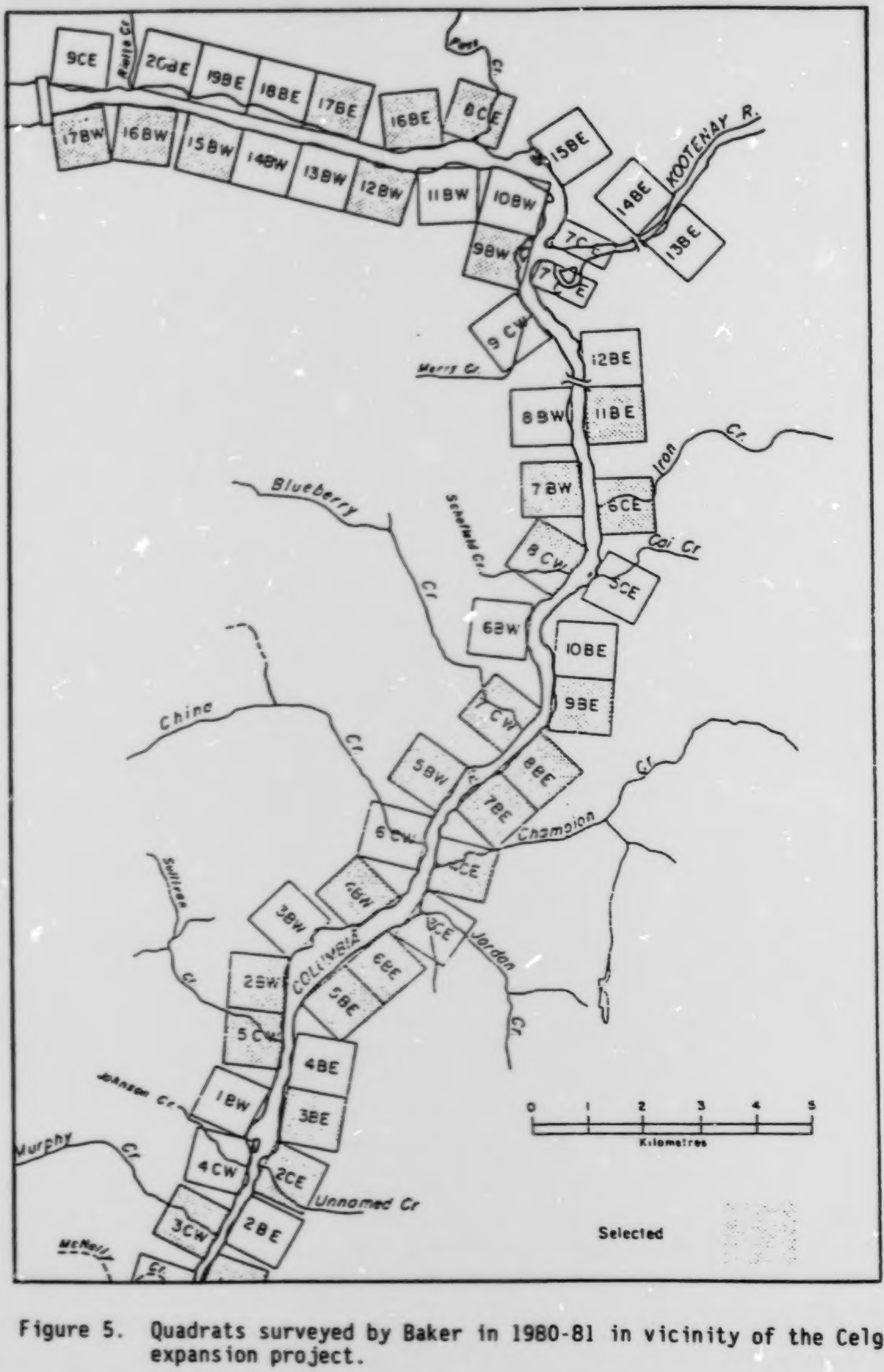

9CE
Rialto Cr.
20BE
19BE
18BE
17BE
16BE
8CE
Fort Cr.
17BW
16BW
15BW
14BW
13BW
12BW
11BW
10BW
15BE
KOOTENAY R.
14BE
13BE
7CE
9BW
7CE
9 CW
Merry Cr.
12BE
8BW
11BE
Iron Cr.
Blueberry
Schofield Cr.
7BW
6CE
Cai Cr
8 CW
5CE
Cr.
6BW
10BE
9BE
7 CW
Chine
Cr.
5BW
8BE
7BE
Champion
Cr.
6 CW
4CE
Sullivan
4BW
3BW
3CE
Jordan
COLUMBIA
6BE
2BW
5BE
Cr.
Cr.
5 CW
4BE
Johnson Cr.
1BW
3BE
Murphy
Cr.
4CW
2CE
Unnamed Cr
3CW
2BE
McNally
Cr.
0
1
2
3
4
5
Kilometres
Selected

Figure 5. Quadrats surveyed by Baker in 1980-81 in vicinity of the Celgar expansion project.

of the Celgar mill. Quadrat 17BW includes all of the effluent treatment plant area, whereas quadrat 15BW includes nearly all of the mill area. Baker did not locate any archaeological sites in these three quadrats, although he did not conduct any subsurface testing during the survey (Baker 1981:30; pers. comm., March 15, 1990).

Later archaeological research in the Castlegar area has included test excavations by Baker (1983) at several sites in the Murphy Creek Dam pondage, and the removal of several burials at the mouth of the Kootenay River (Skinner 1981). Other archaeological work, including surveys and test excavations, have taken place along the nearby lower Kootenay River and in the nearby Slocan Valley (e.g., Turnbull 1971, 1977; French 1973; Galvin 1977; Bell 1979; Eldridge 1981; Mohs 1981; Choquette 1976, 1985).

At least 3300 years of human occupation of the Arrow Lakes area has been recorded. The human use of this area probably has a greater antiquity because people were camping along the Columbia River downstream of Castlegar at the Kettle Falls fishery in Washington State as early as 9,000-10,000 years ago (Chance and Chance 1982). The basic archaeological sequence for the last 3300 years in the Arrow Lakes area was initially proposed by Turnbull (1971, 1977). Mohs (1981) and Eldridge (1984) have expanded Turnbull's sequence, and have proposed changes to it.

The first European to visit the Arrow Lakes - Castlegar area was David Thompson, who followed the Columbia River to its mouth in 1811 (Ormsby 1958:39-40). With the establishment of Fort Colville on the Columbia River in Washington State in 1825, the Colville area became the focus for fur trade activity in that region, including the Arrow Lakes - Castlegar area. The discovery of gold and silver in the late 19th century led to a more intensive non-Indian utilization of the Arrow Lakes - Castlegar area, although the main centres of mining were located to the south (Rossland), east (Nelson), and north (Slocan). Agricultural preemptions occurred in the latter part of the 19th century, and the Doukhobors arrived just prior to World War I to farm. The Kettle Valley Railway (now CP Rail) was extended west from Robson West towards the Boundary mining districts in 1898, paralleling the Columbia River as far as

McCormick Creek. A station was established at Westley Siding, where a sawmill was located (the proposed site of the Celgar effluent treatment plant) (Burrows 1984:91). When the Celgar pulp mill was constructed in the early 1960s, CP Rail installed a new siding named "Kraft" east of Westley to service the mill (Burrows 1984).

The forest industry in the West Kootenay developed late in the nineteenth century as settlement followed further mineral discoveries. The Yale-Columbia Lumber Company was incorporated in 1899 with mills at Phoenix, Rock Creek, Rossland, and Ymir. The company built a new mill at Westley in 1902 (Webber 1973:29). The mill property was bisected by the railway, with the industrial component situated between the track and the river, and a small village for the plant workers landward of the railway (Webber 1973:30). In 1909 the Westley mill was completely destroyed by fire (Webber 1973:32-33). The remaining, unoccupied buildings south of the then Kettle Valley Railway were likewise destroyed by fire in 1925.

A new sawmill was constructed on the same site by the Westley Lumber Company in 1927, and this mill operated until it, too, was destroyed by fire in 1931 (Webber 1973:60). The Westar sawmill, located immediately west of the Celgar pulp mill, was built in the 1960s.

3.0. METHODOLOGY

This section describes the methods and techniques used during the impact assessment.

3.1. ASSESSMENT PLAN

The study consisted of the following tasks:

Background Research

A brief review of the archaeological, ethnographic, and historic literature of the Arrow Lakes - Castlegar area was undertaken in order to provide a cultural and historical context for the study, and to identify the types of archaeological sites which could be expected on the subject property.

Assessment of Archaeological Site Potential

The likelihood of encountering archaeological sites on the subject property was determined prior to the field survey in order to identify those areas which have a reasonable potential for archaeological sites and which should, therefore, be examined during the field survey.

Field Reconnaissance (Survey)

Those areas within the subject property considered to have a reasonable potential for containing unidentified archaeological sites were examined for the purposes of identifying and recording any archaeological sites present.

Site Significance Evaluation and Impact Assessment

Since no archaeological sites were identified during the survey, the study did not include two tasks usually found in an impact assessment, namely, (1) evaluation of the significance of the archaeological sites on the subject property, and (2) identification of all potential impacts on all archaeological sites on the subject property by the proposed development.

Recommendations Regarding Further Work

Based on the results of the background research, site potential assessment, and field survey, the need for additional archaeological work was evaluated, and recommendations regarding further work were made.

Preparation of Assessment Report

A report on the results of the archaeological impact assessment completed the study.

3.2. ASSESSMENT METHODS

Background Research

A literature review examined the published and unpublished archaeological, ethnographic, and historic literature for the Arrow Lakes - Castlegar area. The review relied primarily on documents and reports in the library of Arcas Consulting Archaeologists Ltd, and from the private collection of employee Richard Brolly, but other materials were obtained, including a copy of Harrison's field notes from the B.C. Indian Language Project, and a copy of Anderton's article on the geology of the area from Lesley Anderton. In addition, the Columbia River Basin Series maps at the University of British Columbia Map Library were examined, and telephone discussions were held with several researchers who had worked in that area: Lesley Anderton (geologist, Selkirk College, Castlegar), James Baker (archaeologist, Okanagan College, Kelowna), Randy Bouchard (anthropologist, B.C. Indian Language Project, Victoria), and Wayne Choquette (archaeological consultant, Yahk, B.C.).

Information about the proposed Celgar mill expansion, including copies of development plans and an aerial photo mosaic of the development area, were obtained from H. A. Simons Ltd, project engineers. Archaeological site inventory forms for the area were obtained from the Archaeology and Outdoor Recreation Branch of the Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Assessment of Archaeological Site Potential

In order to determine the potential for archaeological sites on the development property, development plans and an aerial mosaic of the property were examined. This examination divided the development property into two classes of terrain: built-up and completely disturbed land with no potential for intact archaeological sites, and intact or less disturbed terrain with at least some potential for intact archaeological sites.

The preliminary potential assessment based on the in-office examination of aerial photographs and development plans was subsequently tested in the field. Those areas considered to have no archaeological site potential were briefly inspected. The inspection was judgemental in coverage, and consisted exclusively of surface examination. Because the disturbance in much of the development property was severe, no subsurface testing was undertaken. The entire lengths of both of the treatment plant access road and the pipeline route were examined during the in-field inspection. Patches of snow were present throughout the inspection area.

Field Reconnaissance (Survey)

One area within the development property was considered to have a reasonable potential for containing unidentified archaeological sites as a result of the in-office and field assessment of archaeological site potential (Section 4.2.). This area was surveyed for archaeological sites.

The purpose of the survey was to identify any archaeological remains or deposits present either on the surface or buried below surface. The survey consisted of a visual inspection of the surface and of subsurface exposures for artifacts, cairns, butchered animal bone, charcoal deposits, and other kinds of archaeological evidence. No shovel tests were excavated because the subsurface matrix was thoroughly frozen.

The survey techniques used were dictated by the morphology of the area to be examined. The survey area consisted of the side of a former borrow pit, and the surface of a remnant terrace adjacent to the borrow pit side (Section 4.2.). The southeast segment of the borrow pit side consisted of a cut about 15 m high, including 4 m of vertical escarpment at the top of the bank, and could only be inspected from below for buried archaeological remains. Where possible, the bank was climbed for closer examination. Elsewhere, the side sloped more gently. The sloped sections of the bank were covered with snow, providing few exposures which could be checked for archaeological remains. The edge of the bank was also examined from above. The surface of the terrace could not be examined due to the presence of approximately 15-20 cm of snow.

Recommendations Regarding Further Work

Recommendations regarding further work were made based on the results of the background research, site potential assessment, and field survey. The potential for unidentified archaeological sites on the development property was an important consideration in the deliberations which led to these recommendations.

Preparation of Assessment Report

This report on the results of the archaeological impact assessment was produced in a format compatible with AORB guidelines.

4.0. RESULTS

This section contains the results of the archaeological impact assessment for the Celgar expansion project.

4.1. ARCHAEOLOGICAL SITE POTENTIAL ASSESSMENT

Aerial photograph interpretation indicated that all land-altering activities planned for the mill area were to take place on either built-up or completely disturbed terrain on existing mill property. The in-office assessment concluded that these areas had no potential for intact archaeological sites.

Aerial photograph interpretation of the proposed pipeline route concluded that the pipeline would traverse primarily disturbed terrain. The eastern part of the route would be located on the Celgar mill property and the Westar sawmill property, whereas the western part of the route would be located within the CP Rail right-of-way. The in-office assessment concluded that the proposed pipeline route had little potential for intact archaeological sites.

Aerial photograph interpretation of the proposed effluent treatment plant area, including the plant access road, indicated that much of the area to be impacted by construction of the treatment plant would be situated within a former borrow pit excavated about 25 years ago during building of the Hugh Keenleyside Dam. The in-office assessment concluded that the borrow pit had no potential for intact archaeological sites.

Examination of aerial photographs revealed, however, that part of the excavations for the spill pond at the treatment plant were planned for an area between the borrow pit and the Keenleyside Dam road which appeared to consist of the landward remnant of a fluvial terrace (Figure 6). Because the condition of this possible terrace remnant was not known, this area was considered to have at least some potential for surficial or buried archaeological sites. The nature of this potential

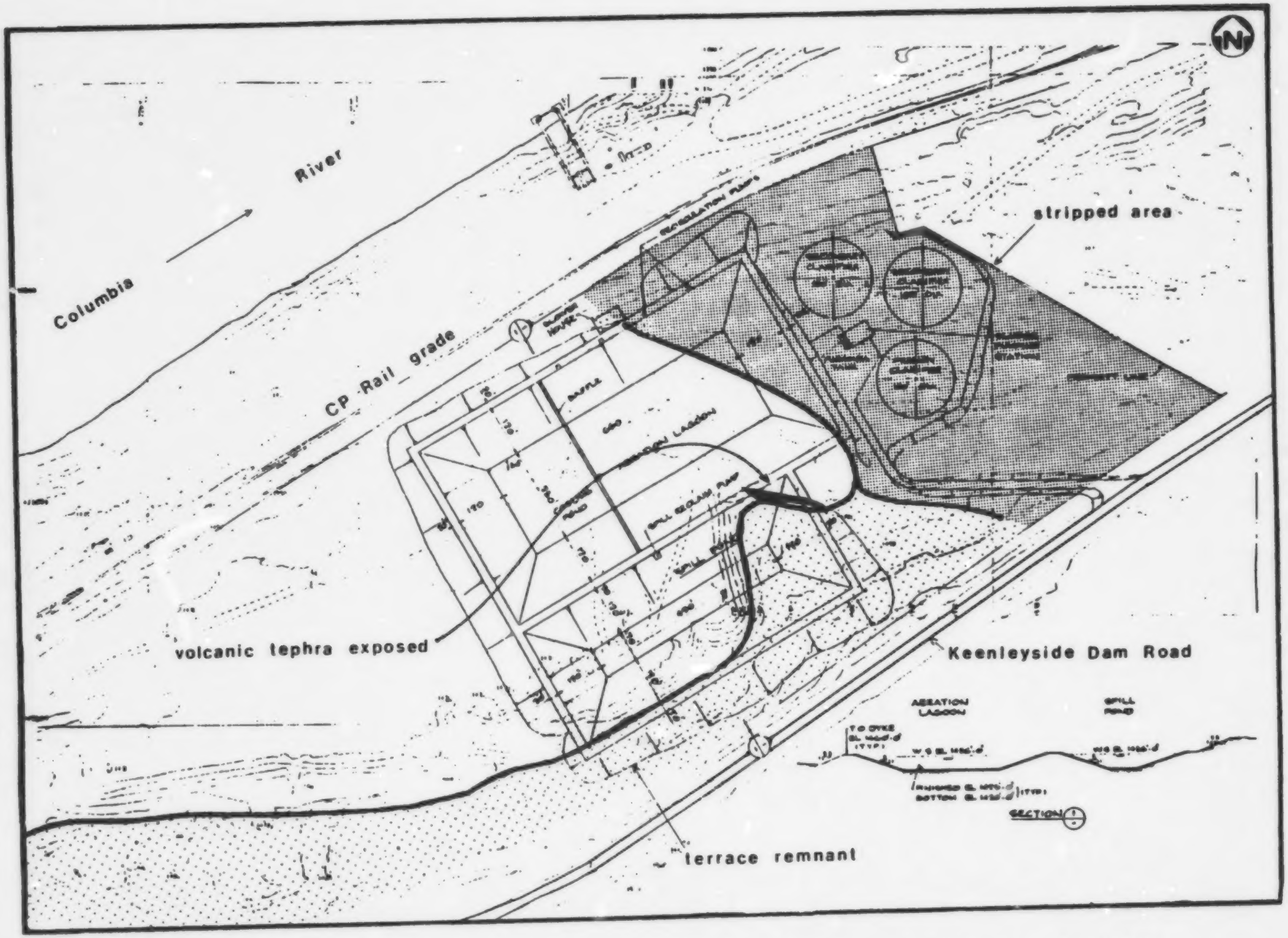

Columbia
River
CP Rail grade
stripped area
volcanic tephra exposed
Keenleyside Dam Road
terrace remnant
AERATION LAGOON
SPILL POND
SECTION

Figure 6. Location of terrace remnant and volcanic ash (tephra) exposure at treatment plant site (circa 1:3600).

could not be determined, although it was anticipated that it would not be high because: (1) no surficial archaeological sites were identified in this area during Baker's survey of the river bank; (2) the archaeological potential of the north-facing right bank appears to be lower than on the south-facing left bank (Harrison 1961b:32-33), and only four sites had been found by Harrison in a circa 7 km section of river bank opposite the Celgar mill and proposed treatment plant; and (3) no streams are present on the development property, and Baker's survey indicated that there was a strong preference for Indian settlement in this region at creek mouths as opposed to river bank locations 1981:47-48).

The field inspection which followed the in-office assessment examined the mill property, pipeline route, and proposed treatment plant area, and confirmed the preliminary in-office site potential assessment. The existing mill property was completely disturbed, and had no potential for intact archaeological sites, whereas the pipeline was to be located on either built-up mill property or disturbed CP Rail right-of-way with no potential for intact sites. The disturbed nature of the rail right-of-way was indicated by the presence of irregular surfaces and the absence of vegetation less than about 20 years in age. The field inspection also noted that the treatment plant, including the plant access road, will be located within a former borrow pit with no potential for intact archaeological sites. The borrow pit can be divided into two areas: a deeply excavated western part and a shallower eastern part which has been stripped to depths of 30 to 200 cm below the present surface of the adjacent terrace remnant (Figure 6). The plant access road is to be built within the stripped portion of the borrow pit.

The field inspection further confirmed that excavation for the proposed treatment plant will extend slightly beyond the south edge of the borrow pit into the back remnant of a fluvial terrace (Figure 6). Although the presence of snow prevented a more definitive site potential assessment of the treatment plant area, this terrace remnant was considered, on the basis of field inspection, to be the only area on the development property with any potential for intact archaeological sites.

4.2. SURVEY RESULTS

No archaeological sites were identified during the field survey of the terrace remnant. No archaeological deposits or remains were observed in the cut bank which forms the side of the borrow pit. Snow cover prevented inspection of the terrace remnant surface. However, the terrace surface may be disturbed since it supports no shrubs or trees.

Although of no apparent archaeological significance, a formation of potential paleoecological interest was identified from the south edge of the borrow pit. Exposed in the vertical cut is a thick (10-15 cm) layer of volcanic tephra (ash), ranging in depth from 0.5 m to 1.5 m below the existing surface (Figure 7). Two ash falls could be expected from this part of the West Kootenay, the 6600 year-old Mazama tephra from Oregon, and the St. Helens W tephra from southern Washington, dated to about 1200 years ago. Although the St. Helens W ash has been observed just below surface in archaeological sites in the Arrow Lakes (Turnbull

Figure 7. Volcanic tephra and possible palaeosol in edge of borrow pit.

1977:30, 31, 106), the depth of deposition and thickness of the well-defined ash layer in the cut bank suggests that this ash is part of the widespread Mazama ash fall. This tentative identification is strengthened by the fact that Mazama ash has been identified on the north bank of the Columbia River at Castlegar by Anderton (n.d.; pers. comm., March 15, 1990).

Immediately below the tephra layer in the cut bank is a 30 to 40 cm-thick layer of dark brownish gray sediment that superficially resembles an archaeological deposit. The layer was observed from about 2 m below, but no artifacts, bones or fire-altered rocks were observed in this layer or on the debris fan immediately beneath. Below this dark layer is a narrow reddish-brown layer, believed to represent an old Bf soil horizon. These two layers appear to be a palaeosol (an ancient, natural soil formation preserved in situ) capped by the volcanic tephra.

5.0. FURTHER WORK REQUIREMENTS

No archaeological sites were observed on that part of the development property considered to have any potential for intact archaeological sites. The rest of the property is completely disturbed, and has not potential for intact sites. Consequently, the Celgar expansion project will not impact any known archaeological sites.

The likelihood that the project will impact unidentified intact archaeological sites is nonexistent at the mill, along the pipeline route, and in the borrow pit at the proposed treatment plant. It is recommended, therefore, that (1) NO FURTHER ARCHAEOLOGICAL ASSESSMENT BE UNDERTAKEN FOR THE MILL AREA, PIPELINE ROUTE, AND BORROW PIT PORTION OF THE PROPOSED EFFLUENT TREATMENT PLANT.

The potential for unidentified intact archaeological sites in the area of the terrace remnant at the proposed treatment plant is considered to be low. The low rating is assigned to the terrace remnant based on the following considerations:

(1) no surficial archaeological sites were identified in this area during Baker's survey;

(2) the archaeological potential of the north-facing right bank appears to be lower than on the south-facing left bank (Harrison 1961b: 32-33);

(3) Baker's survey indicated that there was a strong preference for Indian settlement in this region at creek mouths as opposed to river bank locations 1981:47-48), and no creeks are present on the development property;

(4) the terrace remnant consists of a portion of the back of the terrace near the toe of the steep valley side. This area would be the least likely part of the landform to contain prehistoric Indian remains, since most settlements (villages, camps, etc.) would be located close to either a creek or the river; and

(5) the terrace surface may be disturbed based on the absence of trees and shrubs.

About 10,000 m² of the terrace remnant will be impacted by excavation for the effluent treatment plant. Given the low potential for unidentified intact archaeological sites in this area, it is recommended that (2) NO FURTHER ARCHAEOLOGICAL ASSESSMENT BE UNDERTAKEN FOR THAT PART OF THE TERRACE REMNANT WHICH WILL BE IMPACTED BY EXCAVATIONS FOR THE PROPOSED EFFLUENT TREATMENT PLANT.

Although the potential for unidentified intact archaeological sites is considered to be low, any site present in association with the volcanic ash and possible palaeosol would be of very high scientific significance because of its antiquity. As a result, it is recommended that (3) EXCAVATION OF THE TERRACE REMNANT FOR THE PROPOSED EFFLUENT TREATMENT PLANT BE MONITORED BY A QUALIFIED ARCHAEOLOGIST. The purpose of the monitoring is to assess the nature of any impacts which may take place on unidentified archaeological sites in the terrace remnant area, and to implement emergency impact measures (AORB 1989:17). Several emergency actions have been defined by the AORB. To ensure the successful implementation of recommendation (3), it is recommended that (4) THE EXCAVATION CONTRACTOR BE INFORMED THAT THE EXCAVATION OF THE TERRACE REMNANT WILL BE MONITORED FOR ARCHAEOLOGICAL REMAINS, AND THAT THE EXCAVATION COULD BE DELAYED OR HALTED IF SIGNIFICANT ARCHAEOLOGICAL DEPOSITS ARE ENCOUNTERED.

REFERENCES CITED

Anderton, L. J.
n.d. The terraces and surficial geology of the Columbia Valley at Castlegar, B.C. Castlegar News, circa 1977. Castlegar.

Archaeology and Outdoor Recreation Branch
1989 British Columbia Archaeological Impact Assessment Guidelines. Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Baker, James
1981 Murphy Creek Project: heritage resources study - Stage 1 report prepared for B.C. Hydro and Power Authority. Copy on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

1983 Murphy Creek Project: heritage resources detailed impact assessment. Report prepared for B.C. Hydro and Power Authority. Copy on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Bouchard, R., and D. I. D. Kennedy
1985 Lakes Indian ethnography and history. Copy on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Burrows, R. G.
1984 Railway Mileposts: British Columbia. Volume II: The Southern Routes from the Crowsnest to the Coquihalla. Railway Milepost Books, North Vancouver.

Choquette, Wayne
1976 Archaeological site inventories in the Kootenay Region: Summer 1975. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

1977 Summary Report: 1977 Kootenay Regional Survey. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

1985 Salvage excavations at DiQj-18: a test model of Upper Columbia Basin human settlement dynamics. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Cox, William George
1861 Letter and report to James J. Young, October 19, 1861. Colonial Correspondence File F/376/24, British Columbia Archives and Records Service, Victoria.

Dawson, G.
1892 Notes on the Shuswap people of British Columbia. Proceedings and transactions of the Royal Society of Canada for the year 1891. 9:2:3-44. Dawson Brothers Publishers, Montreal.

Eldridge, Morley
1981 The Heritage resources of the Slocan Valley: an inventory and evaluation. Report on file, B.C. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Eldridge, Morley
1984 Vallican archaeological site (DjQj-1): a synthesis and management report. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Elmendorf, William W.
1935-1936 Lakes ethnographic notes taken in 1935 and 1936. Original on file with the author, University of Wisconsin, Madison; photocopy on file, B.C. Indian Language Project, Victoria.

French, Diana
1973 Nelson Archaeological Project: results of the investigation of a stratified campsite, DiQi-1, near Taghum, B.C. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Galvin, Eileen
1977 Taghum Bridge Site (DiQi-2) salvage excavation and preliminary analysis. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Harrison, Peter
1961a Field notes of archaeology survey of the High Arrow Reservoir. Originals held by the Archaeology Laboratory, University of British Columbia, Vancouver.

1961b Report on the archaeological survey of the High Arrow Reservoir. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

McTavish, Dugald
1856 Letter to Secretary of the Hudson's Bay Company, Vancouver, June 23, 1856. Hudson's Bay Company Archives, Winnipeg. A.11/71/652.

Mitchell, Donald H.
1967 Archaeological investigations, Summer 1966. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Ormsby, M.A.
1958 British Columbia: a History. The Macmillan Company of Canada, Ltd., Vancouver.

Ray, V. F.
1936 Native villages and groupings of the Columbia Basin. Pacific Northwest Quarterly 27: 99-152.

1939 Cultural relations in the Plateau of northwestern America. Publications of the Frederick Webb Hodge Anniversary Publication Fund 3.

Robinson, Michael and Paul St. Pierre
1973 Department of Highways archaeological survey final report. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Skinner, Mark
1981 Summary analysis of archaeological skeletal remains FRC81-26. Report on file, Ministry Library, Ministry of Municipal Affairs, Recreation and Culture, Victoria.

Teit, J. A.
1909 The Shuswap. Memoirs of the American Museum of Natural History 4:7:447-758.

1930 The Salishan tribes of the western plateaus. Forty-fifth Annual Report of the Bureau of American Ethnology 23-396.

Turnbull, Christopher J.
1971 Recent archaeological fieldwork in the Arrow Lakes, B.C. in Stryd, A. H. and R. A. Smith (eds.) Aboriginal Man and Environments on the Plateau of western North America 44-55. The Student's Press, Calgary.

1977 Archaeology and ethnohistory on the Arrow Lakes, southeastern B.C. National Museum of Man Mercury Series. Archaeological Survey of Canada Paper 65.

Webber, H.
1973 People & Places. Cotinneh Books, Castlegar.

Work, John
1830 Some information relative to the Colvile District, Fort Colvile Report 1830. Hudson's Bay Company Archives, Winnipeg. B45/e/3.

APPENDIX E

Provincial Government Agency Comments

Province of
British Columbia

Ministry of Environment
Policy and Planning Branch
Parliament Buildings
Victoria, B.C.
V8V 1X5

MEMORANDUM

To: David Parsons, Aldyen Donnelly, Co-Chairmen, MPSC

Date: 03-12-90

RE: Celgar Pulp Expansion Proposal - Prospectus Review

The Environmental Impact Assessment report submitted as a prospectus under the Major Project Review Process by Celgar Pulp Company for their bleached kraft pulp mill expansion/modification at Castlegar has been reviewed by the Ministry of Environment. The report presents a description of the existing and new mill plans, outlines impacts of these plans and identifies data gaps.

The proposed expansion/modification involves four main components--extended digestion, oxygen delignification, chlorine dioxide substitution, and effluent treatment. The Prospectus indicates that effluent quantities to be discharged will be reduced. Biochemical oxygen demand (BOD) and clorinated organics (AOX) are predicted to decrease. Total suspended solids (TSS), however, are expected to increase, but as biosolids not fibre. It is estimated that the overall emission rates of TRS and particulates will decrease, but that of SO_2, NO_x and moisture will increase.

It is noted that the proposed expansion should meet the Ministry's proposed 1994 requirements with respect to chlorinated organics (ie 1.5 kg AOX/T). In fact, these requirements may be met as early as 1993. The expansion will not meet the proposed interim requirement to reduce AOX levels to 2.5 kg AOX/T by December 31, 1991, however, due to the lead time required for construction. Although the Ministry would obviously prefer that both levels be attained, it is considered more important that a realistic schedule be developed by which all aspects of the mill effluent discharges be brought into compliance. To this end, the Ministry is prepared to waive the 1991 requirement in recognition of the mill's construction schedule and given that the mill should meet the more stringent 1994 regulation early.

In general, better documentation of predicted effluent and emission quality is needed, and the proponent should expect to meet permit limits reasonably achieved by best available control technology (BACT). Prediction of environmental impact should be based on BACT rather than the 1977 Pollution Control Objectives Level A, if BACT is feasible and produces better effluent or emission quality.

The Ministry's review of this prospectus has identified a number of significant deficiencies. These are summarized below and outlined in detail in the attached Appendix.

Effluent Discharges

1. The report does not adequately consider the fate of chlorinated organic compounds in the effluent at the expanded mill. For example, the quantity of total AOX which will be present at each stage of the mill process, and the species of AOX which will be separated out at the various stages of treatment should be outlined. It is not stated whether the 1.5 kg AOX/t limit given by Celgar represents the most persistent forms of AOX or if these are the most toxic or most likely to accumulate in the food chain.Celgar may have underestimated biosolids as a source of AOX. To avoid problems there should be a greater emphasis in the treatment process to reduce biosolids to as low a concentration as possible.

2. The proponent should explain why some chlorine bleaching is still required and why alternatives, such as hydrogen peroxide bleaching cannot be substituted to further reduce AOX. If not now feasible, the mill should be designed with sufficient flexibility to incorporate this technology later.

3. Existing solids on the river bottom represent an issue that needs to be resolved, irrespective of mill expansion. These solids have accumulated from many years of effluent discharge and log handling. Fibre from past effluent discharges is likely a major source of AOX entering the food chain. Celgar must address the removal or management of these solids as part of the expansion proposal.

4. The impact of mill expansion on water quality, biota and sediments in the Columbia River, immediately downstream of the mill and at the International border, should be predicted. This should include measurement of chlorinated organic compounds in the existing effluent and extrapolation to the border based on dilution and accounting for losses in sedimentation and other factors.

   Potential changes in the flow regime of the Columbia River due to proposed expansion/modification of B.C. Hydro's power generating facilities should be incorporated in this analysis to the extent possible.

Air Emissions

1. Celgar should ensure that the additional sulphur input to the #2 Power Boiler from the burning of HVLC gases and clarifier sludge as well as LVHC gases, are taken into account in the SO_2 emission rate.

2. The proponent should ensure that the burning of LVHC gases in the lime kiln has been taken into account in estimating SO_2 stack emission rates.

3. Celgar's prospectus fails to present the estimated air quality influence of the existing mill, making evaluation of the changes in air quality due to expansion of the mill impossible. The model for predicting air quality impacts should be re-run using current meteorological data to determine effects of the existing mill on local air quality. Features of the local weather not incorporated in the dispersion modelling that would affect the air quality should be assessed in the report.

4. The proponent should supply maps showing isopleths of maximum pollutant concentrations for the existing and expanded mill to assess spatial variability of impacts and frequencies of net air quality levels in excess of level A and level B for each contaminant.

5. Celgar should assess contingency plans to further reduce TRS and SO_2 emissions if found necessary by modelling or in the event that air quality deteriorates due to meteorological conditions. In this regard, the proponent should consider using BACT to treat SO_2 from the recovery boiler.

6. The proponent has not sufficiently evaluated the impacts of burning secondary effluent treatment sludge in the power boiler. This is a significant issue given the anticipated concentrations of chlorinated organics in the sludge. This Ministry will not approve incineration of these sludges based on the information supplied in the EIA.

7. The report may have underestimated the visibility impairment due to the expanded mill by not including the impacts of SO_2 oxidation.

Fibre Supply

An analysis of fibre supply is needed to determine the use of pulp logs or wood chips in the expanded mill, as the nature of this supply could have a major impact on air and water quality and on fish and wildlife habitat. Increased logging activity could have impacts on water quality, fisheries and wildlife habitat. At the same time, unused chips represent potential impacts on water and air quality from landfill leachates and beehive burner emissions.

The necessity for a pulpwood harvesting licence should be clarified. A fibre supply analysis would also serve as an appropriate basis for evaluating transportation options.

Recommendations

1. The concerns of this Ministry must be addressed by Celgar in a Stage I submission to the Major Project Steering Committee. It is suggested that specific terms of reference to address each of the concerns outlined above, and described in detail in the attached Appendix, be developed by the company in consultation with the Ministry. To arrange a meeting for this purpose, the company is advised to contact Garry Alexander at 387-9675.

2. To accommodate the extensive public interest in the Celgar Project, it is also recommended that the Steering Committee initiate a program of public consultation, including public information meetings, during the Stage I review.

Doug Dryden

Doug Dryden
Director
Environmental Assessment

cc: Dennis McDonald
Sheila Wynn
Jon O'Riordan
Ministry Review Participants

APPENDIX

1.0 Effluent

1.1 The proponent must explain why some chlorine bleaching is still required and why alternatives such as hydrogen peroxide cannot be substituted at this time. If it is not feasible to use it now the proponent should indicate how mill design will accommodate addition of this technology at a later date.

1.2 The report should deal more specifically with the fate of chlorinated organics (AOX) generated at the mill. The following questions need to be addressed:

- a) How much AOX will remain with the primary solids?
- b) How much AOX will remain with the secondary solids?
- c) How much AOX will pass through the effluent treatment system?
- d) What species of AOX are likely to be separated at the various stages of treatment?
- e) Does the 1.5 kg AOX/t limit represent the most persistent forms of AOX and are these the most toxic or the most likely to accumulate in the food chain?

1.3 Biochemical Oxygen Demand (BOD) and suspended solids (TSS) levels in mill effluent provide an indication of biosolids loadings. The Ministry of Environment is concerned that chlorinated organics will be associated with biosolids from the activated sludge system. These biosolids make up most of the solids in the proposed discharge. Chlorinated organics associated with biosolids will be available for biological uptake. The proponent has used current Provincial Level A objectives for determining loadings of BOD and TSS in mill effluent. Instead, an assessment of BOD and suspended solids concentrations should be based on levels that can be realistically achieved with the technology proposed (in this case, the best available technology). The Level A concentrations are less stringent than can be achieved using the proposed technology and the proponent should not assume that permit limits will be based on the Level A objective. There should be an emphasis on reducing biosolids to as low a concentration as possible even if it means flocculation or extended treatment.

1.4 The proponent should provide information that the proposed extended aeration activated sludge system is capable of meeting the 100% 96 hr LC50 value prior to dilution with cooling water at the foam tank. The proponent should be aware that the design of the location of sampling equipment will be critical to obtaining a true flow proportional sample of effluent. The issue of sampling procedures (grab or composite) will be addressed as part of the permitting system.

1.5 There is a need to predict the individual resin acid concentrations after treatment using data from other mills. The proponent should substantiate claims made in the report for a reduction from 216 kg/d to 20 kg/d in resin acids.

1.6 The proponent should substantiate estimates of changes to effluent colour with the expansion. Based on the effluent concentration predicted there is a slight exceedence of the CCREM guideline of 15 TCU between the initial dilution zone and the complete mix area during low flow periods.

1.7 The issue of untreated effluent discharging to the river in the event of power failure is of concern to the Ministry of Environment. Calculations of the volume and estimates of effluent quality and predicted frequency of failure must be made by the proponent to allow an assessment of the need for emergency power.

2.0 Receiving Water

2.1 The consultant has referred many times to ambient quality objectives in the Pollution Control Objectives for the Forest Products Industries of British Columbia. These objectives are outdated. Instead, the Ministry's Water Quality Criteria documents and CCREM guidelines should be used consistently throughout the report as has been done for nitrogen and algal productivity.

2.2 Existing solids on the river bottom represent an issue that needs to be resolved. The contribution from log handling at both the sawmill and the pulpmill historically has resulted in a heavy deposit of log debris on the bottom. This is in addition to a buildup of settleable solids downstream of the pulpmill effluent diffuser that results from flyash, lime mud and fibre losses. Fibre losses related to pulpmill effluent discharges are likely a major source of chlorinated organics entering the food chain.
With regard to the fibre mat, a number of issues must be addressed by Celgar regardless of whether expansion proceeds:

a) The surface area and depth of contamination in the vicinity of the mill must be better defined.

b) Methods by which the foreign bottom material can be safely removed or sealed to result in an acceptable environmental impact must be presented.

c) In the event that this material is to be removed, the manner and location of its disposal must be outlined.

d) The characteristics of the fibre mat must be determined, particularly with respect to historical dioxins and other chlorinated organics to determine if the material must be considered as a Special Waste.

e) Alternatives to water storage and handling of logs should be explored to avoid further fibre buildups.

Celgar must address the removal or management of these solids as part of the expansion proposal.

2.3 The terms of reference given to the proponent by the Ministry of Environment required the prospectus to evaluate impact scenarios with proposed B.C. Hydro Dam construction and modification. This has not been done. The Ministry appreciates Celgar's position that they do not have enough information to do this evaluation. However, we strongly recommend that Celgar continue discussions with B.C. Hydro to determine to what extent Hydro's plans (particularly with respect to the Keenleyside facility) may alter the flow regime of the Columbia and therefore affect the acceptability of Celgar's effluent discharge.

Furthermore, if B.C. Hydro intends to dredge Tin Cup Rapids downstream of the pulpmill, they should discuss this at an early date with Celgar. As noted above, the sediment may be Special Waste and will have to be treated accordingly by Celgar and B.C. Hydro. The Ministry will be pleased to meet with representatives of Celgar and Hydro to discuss this issue.

2.4 The potential for increased algal growth in the river due to the mill expansion needs to be more adequately addressed. Ministry of Environment information indicates that there are significant growths of algae and fungus that negatively affect habitat in the area. The proponent should reassess the potential for nutrient production from the mill process and provide supporting documentation for the estimates of nitrogen and phosphorous levels. Since biosolids from the treatment process provide a source of nutrients, flocculation of the waste stream prior to final clarification would assist in reducing this potential impact.

2.5 The proponent should attempt to predict the impact of the expansion on water quality, biota and sediments at the international border and at other locations indicated by Environment Canada in January 30, 1990, letter, Churchland to Crosier. Although not included in the original Terms of Reference provided by our Nelson office this impact prediction must be done.

This should include measurement of chlorinated organic compounds (chlorinated phenols, resin acids, fatty acids, guaiacols, catechols, dioxins, furans and AOX) in the effluent and extrapolation to the border based on dilution. The impact of assimilation or sedimentation should be determined by actual measurements of Columbia River water coinciding with effluent measurements.

3.0 Air Contaminant Emissions

3.1 The proponent should estimate emission rates from the plant based on the plant production rate expressed as a consistent unit. Further, the emissions of contaminants should be provided separately for both the maximum design case and the average plant production.

In the current prospectus, the new mill capacity has been given as: "average of 1200 ADT/d of bleached marked grade kraft pulp" (p. 10), as "operating capacity to 1398 ADUT" (p. 45), and "at rated capacity" (Table 3.9, p. 47). This raises some uncertainty regarding the comparability of emission estimates provided in various sections of the report.

3.2 The proponent should set out the assumptions used to estimate the maximum emission rate of each contaminant. Specifically, it should be confirmed that emission rates are maximum 1-hr values. In addition the proponent should provide the sulphur composition of HVLC, LVHC and the clarifier sludge along with the input rates to the boiler. Also, more detail of the NOX emission rate estimates from the boiler will be necessary.

3.3 The proponent should verify the efficiencies of the various emission control devices listed on p. 42-43 as has been done for the recovery boiler electrostatic precipitator.

3.4 Celgar proposes to use the #2 Power Boiler to burn HVLC gases and clarifier sludge as a routine, as well as to burn LVHC gases when these can not be burned in the lime kiln.

However, the AP-42 emission factors used in the report are for bark and wood burning only. The proponent should clarify whether this additional sulphur input to the boiler has been taken into account to estimate the SO_2 emission rate. If not, then revised SO_2 emission rates should be presented.

CIRRUS consultant's extrapolation of the Prince George test burn of penta-chlorophenol contaminated woodwaste to the burning of secondary effluent treatment sludge in the present proposal is not adequate for the Ministry of Environment to approve the incineration proposal. The Ministry of Environment will require an expert review of this proposal because of the burning of chlorinated organics in #2 Power Boiler, and the concentration of chlorinated organics in the sludge. We suggest that Environment Canada be contacted to determine if a literature review has been done. The proponent must research this issue as extensively as possible to determine if other mills burning sludge have been evaluated for chlorinated organic combustion products.

3.5 The proponent should confirm whether the impact of burning LVHC gases in the lime kiln has been considered in the prospectus. It is essential to know how much SO_2 removal occurs in the kiln so that the stack emission rate can be verified. The proponent should clarify the statement on p. 45, "SO_2 emission rates will be controlled predominantly by the combustion process in the kiln". The combustion process itself does not control SO_2, rather it is produced during combustion. Any SO_2 removed in the kiln results from the reaction between the lime produced in the kiln and the SO_2 in the kiln gas.

3.6 Because of predicted level A excursion of ambient SO_2 concentrations and the availability of equipment to scrub this gas, the proponent should address the advantages and disadvantages of providing this treatment on the recovery boiler.

3.7 The proponent should provide an assessment of what could be done at the mill to further reduce TRS and SO_2 emissions in the event air quality for these parameters deteriorates due to meteorological conditions both in the short and long term periods of air quality deterioration.

3.8 The proponent should provide information on the advantages and disadvantages of utilizing cooling towers as an alternative to the proposed spray effluent cooling system. The Ministry has concerns with possible TRS emission and fog formation from a spray effluent cooling system.

4.0 Air Quality

4.1 In the Terms of Reference for the air quality assessment, the Ministry of Environment requested the proponent develop estimates of the spatial and temporal variability of the impacts on local air quality at both the existing mill and proposed expanded mill. Such estimates were to be developed for the principal pollutants emitted from the mill. (TRS, SO2, NOX, Particulates)

The proponent failed to present the estimated air quality influence of the existing mill, thus making it impossible to evaluate changes in air quality associated with the expansion. This deficiency must be corrected.

4.2 A shortcoming of the model is that is does not deal with complicated situations such as fumigation events or the "plug flow" scenario which we know to occur in the valley. (ie. where pollutants accumulate in the valley at stack height and then overturn all at once due to ground warming, or when light winds blow pollutants up the Arrow Lake valley in the morning and back down toward Castlegar in the afternoon). These factors will probably cause higher concentrations than predicted in a temporal pattern similar to what is observed now. The proponent should consider the effect of these events on TRS concentrations in the area. Similarly, the additive or potential synergistic impact with pollutants (ie SO_2 and particulates) from other point sources in the valley (eg Cominco) has not yet been addressed.

4.3 The proponent needs to address the following issues with respect to dispersion modelling and impact assessment:

a) The dispersion model needs to be rerun to determine the change in areal distribution of all pollutants for the existing and expanded mill and the consequent improvement/degradation of air quality in the vicinity of the mill.

b) Maps showing isopleths of maximum concentrations of pollutants for the various averaging periods for the existing and expanded mill should be completed.

c) The meteorological data that were missing to complete one year of record (September-December) need to be added.

d) The frequency of net air quality in excess of short and long term level A and level B air quality objectives at each receptor should be provided by the proponent for the existing and expanded mill.

e) The proponent should confirm that maximum emission rates expected for normal operations (described as the 99th percentile rate) were used in the model. The Terms of Reference required that these rates be used and any variation in emission rates and other emission characteristic should be specified.

f) Since no acceptable spatial and temporal air quality patterns have been produced for the mill expansion, an assessment of impacts of the discharges and emissions on the terrestrial environment cannot be completed. Terms of reference will be developed with the company at a later date.

4.4 The effluent treatment system (pond) has been identified as a major emission source and should have been treated as an "area" emission source. In the present modelling and evaluation, this source was not included in the RTMD model evaluation due to a model limitation. It was considered as a "point" source, in the MPTER modelling. The existence of the effluent treatment system should be dealt with using a more appropriate dispersion model such as the Industrial Source Complex (ISC) Model as suggested in the MOE Terms of Reference.

The proponent should substantiate the decision to use the emission rate of 2.778 g/s TRS from the effluent pond and/or document the use of another rate if more appropriate.

4.5 The proponent should address the impact of the oxidation of SO2, particulate matter and water vapour on visibility. Specifically:

a) The particle size of emission from electrolytic precipitators and the fate of these particles must be provided. Evaluation of ambient PM_{10} must be addressed.

b) The scattering from sulphate particles from SO_2 oxidation should be included in the evaluation since this source may degrade visibility.

4.6 The following comments are based on the computer input-output files associated with the air quality modelling that were obtained directly from CIRRUS for review and verification:

a) The emission sources and rates should be verified and confirmed as the design values for this mill; the TRS source identified as "SOAP" in the input file was not included in Tables 3.7 and 3.8 of the report but was included as a TRS emission source in the modelling evaluation.

b) There was a source labelled "Others" in the input files. It should be confirmed as to whether they are real sources with design emission rates or just imaginary sources representing the difference between the design emission rate and that allowed for a "Level A" mill. Only real sources are to be modelled and evaluated.

c) Explanations are needed to resolve the discrepancies noted in the following pairs of input/output files of emission rates:

i. RTPARLT.IN AND RTPARLT.OUA
ii. RTSO2LT.IN AND RTSO2LT.OUA
iii. RTSO2ST.IN AND RTSO2ST.OUA
iv. MPSO2LT.IN AND MPSO2LT.OUA
v. MPSO2ST.IN AND MPSO2ST.OUA

d) The computer modelling runs using the designation "ST" and "LT" for SO2 using both the RTDM and MPTER Models were not mentioned in the report. A clear explanation of these runs is needed.

e) The distribution of the receptor points (as indicated on the plot of receptors that was provided directly from CIRRUS) shows a deficiency of receptors in the areas to the northwest, north, northeast and east of the plant site on the land immediately across the Columbia River on the lower slopes. This deficiency and wide gap where there were no receptor points did not allow the determination of the maximum and the total areal impacts of the mill in the whole modelling domain and missed the impact of the mill emission on the inhabited areas located therein. Due to the proximity of this area to the plant site, the impact of the mill on air quality is expected to be more significant than on the six other, arbitrarily selected sites. If data are available for these points, it should be included in the present evaluation. If not, such data should be collected.

5.0 SOLID WASTE

The collection of land fill leachate at the expanded mill must be addressed. Leachate should be piped to the spill pond.

6.0 STORM WATER COLLECTION

A storm water collection system that will facilitate capture of any spill or contaminated runoff in the mill yard area should be included in the mill design.

7.0 WATER SUPPLY

The proponent should provide information on any additional water to be diverted from Lower Arrow Lake to supply the proposed mill expansion.

8.0 Glossary

The proponent should include a glossary in the next submission to assist in interpreting the report.

**Province of
British Columbia**

Ministry of
Regional and
Economic Development

**712 Yates Street
Victoria
British Columbia
V8V 1X5**

March 8, 1990

Ms. Aldyen Donnelly
Coordinator
Major Project Steering Committee
Ministry of Regional and
  Economic Development
4th Floor
712 Yates Street
Victoria, British Columbia
V8V 1X5

Dear Ms. Donnelly:

Re: Celgar Mill Expansion Prospectus Report

The Ministry of Regional and Economic Development strongly endorses this project and the positive impacts that should result.

Having reviewed Celgar's Prospectus documents, this Ministry recommends that the project be granted Approval-in-Principle, subject to Celgar agreeing to:

1. the establishment of a committee with company representation to monitor and evaluate the social and economic impacts of the construction phase of the project on the City of Castlegar;, and
2. the evaluation of alternatives for transporting chips to the mill to verify that the most efficient mode has been selected.

Celgar is a key employer in the Castlegar area. Directly employing approximately 300 residents, it is estimated that an additional 1,000 jobs in the region are indirectly related to the activities of the mill. In modernizing the mill to meet current and expected environmental standards, Celgar is ensuring not only a reduction in negative impacts on the environment, but greater economic security for the community and the West Kootenays as a whole.

.../2

We believe it is important to consider the alternatives to proceeding with this project. While it is difficult to define with any certainty the consequences of withholding a timely Approval-in-Principle, a potential outcome is that the company would continue to operate under its variance order until 1994. At that time, or earlier, the provincial and federal governments may have to consider shutting down the mill, thus causing substantial economic dislocation and hardship. This would be a tragic result.

Yours sincerely,

for

W. E. Freeman
Director
Industrial Development
and Policy

Province of British Columbia
Ministry of Forests

MEMORANDUM

To: Ms. Aldyen Donnelly
MRED Coordinator
Major Project Review Process
Ministry of Regional and
and Economic Development
712 Yates Ave.
Victoria

5:3
GFK.

From: Industry Development Branch

Date: March 6, 1990

Our File: 870-4-9

Your File: 232-20-030

Re: Proposed Celgar Expansion

Celgar has not provided sufficient information to allow us to assess their proposal in any detail. The submission states that the new mill will require about 1.3 million m^3 of additional chips. They propose to purchase all available by-product chips from regional sawmills. There is no indication as to the geographic area covered in their purchase plans.

At the present time, Celgar purchases chips from both the East and West Kootenays. Based on our mill data, the long-term by-product chip production from the annual sawlog harvest in this area is about 2.3 million m^3. The two pulp mills in the region currently use about 2.2 million m^3 leaving 0.1 million m^3 as surplus. It should be noted that because of short-term increases in the AAC and some private timber, there may be a larger surplus at times.

In supplemental information handed out at the open house in Castlegar, Celgar indicated that they expect to obtain up to 90% of their required wood supply from sawmill by-product chips. To do this would require that chips be transported from the Okanagan area of the Kamloops Forest Region. No details were provided on transportation routes.

Celgar proposed to reactivate their wood room and process round wood. The submission does not indicate what volume they expect to process or where this volume will come from. We would expect that a large portion will come from Westar's TFL 23. It is also expected that other operators in the area would sell pulp logs from present harvesting areas to Celgar.

The chip supply could also be increased through all operators harvesting to a higher utilization standard. If there is an increased market for chips, we expect that the supply from existing sawmills could be increased by at least 10% without any increase in the timber harvest.

When Celgar provides a more detailed description of its fibre supply plans, we will carry out a more detailed analysis.

V.A. Holm
Resource Consultant
Industry Development Branch

**Province of
British Columbia**

Ministry of
Municipal Affairs
Recreation and Culture

Parliament Buildings
Victoria
British Columbia
V8V 1X4

File 610.3

January 25, 1990

161

Mr. Frank Blasetti
Acting MPRP Coordinator
Regional Planning and Infrastructure Branch
Ministry of Regional and Economic Development
4th Floor, 712 Yates Street
Victoria, B.C.
V8V 1X5

Dear Mr. Blasetti:

Re: Proposed Celgar Pulp Mill Expansion

Further to your December 28, 1989 request, we have completed our review of "Bleached Kraft Mill Expansion Environmental Impact Assessment" by E.V.S. Consultants Ltd. and Cirrus Consultants, and offer the following comments for consideration.

GENERAL

As discussed at the January 18, 1990 Major Project Steering Committee (MPSC) meeting, this environmental impact assessment (EIA) contains a level of information which is in between a Propspectus and a Stage 1 Report. Confusion with respect to the information which should be included in this submission is likely related to the fact that this project did not enter the new Major Project Review Process (MPRP) at the beginning of the process. In this regard, the project proponent would have benefitted from a pre-application meeting with the MPSC to obtain guidance concerning information requirements.

Review of this submission as a Prospectus has resulted in the identification of the following deficiencies: 1) the project description does not contain enough information on ancillary facilities to determine the potential environmental effects of these facilities, 2) the discussion of environmental impacts does not address all land use and environmental concerns, i.e. air quality, water quality and aquatic resources are addressed, whereas land use, wildlife, aesthetics, archaeology and outdoor recreation are not, and 3) public consultation is not addressed. Therefore, it is recommended that a Stage 1 submission be required for this project, and that approval-in-principle be deferred until all outstanding issues have been satisfactorily addressed.

...2

ARCHAEOLOGY

As noted above, this EIA does not address potential project impacts on archaeological resources. While it is stated that the project primarily involves construction of a new pulp mill on the disturbed site of the existing mill, there is no information provided concerning the extent of present land disturbance within the mill area. Furthermore, while several ancillary facilities are mentioned, the information provided is inadequate in terms of determining the specific location and layout of the various facilities.

An archaeological impact assessment (AIA) is required, pursuant to British Columbia Archaeological Impact Assessment Guidelines (AORB 1989), in order to identify project impacts on archaeological resources and propose effective impact management measures. This AIA should combine an overview with an impact assessment. The overview should assess the archaeological resource potential or sensitivity of all areas proposed for ancillary facilities including the effluent treatment system, pulp mill access road, rail spurs, parking lot, new solid waste disposal site, etc. The impact assessment should be undertaken for project facilities (including the mill site if undisturbed areas are identified) which have been identified through the overview as having archaeological resource potential. This assessment should entail a comprehensive inventory and resource evaluation, assessment of project impacts, and viable impact management recommendations. A permit will be required, under authority of the Heritage Conservation Act, to alter protected sites for the purpose of evaluating site significance. In this regard, a qualified archaeological consultant will have to document the proposed impact assesssment study on an "Application for Permit" form prior to the initiation of field studies.

OUTDOOR RECREATION

The Archaeology and Outdoor Recreation Branch has not identified any potential project impacts on outdoor recreation resources.

Should you have any questions concerning these comments, please contact me at your convenience.

Sincerely,

R. A. Kenny
Senior Coordinator
Archaeology and Outdoor
Recreation Branch

RAK/ds
pc: J. Pike, D. Suttill, D. Parsons

Province of British Columbia
OFFICE OF THE MINISTER

Ministry of Municipal Affairs, Recreation and Culture

MEMORANDUM

File 610.3

April 9, 1990

760

BR

Ms. Aldyen Donnelly
MPSC Co-Chairperson
Regional Planning and
Infrastructure Branch
Ministry of Regional and
Economic Development

Re: Celgar Pulp Mills Ltd., Bleached Pulp Mill Expansion

As discussed in our recent telephone conversation, I am forwarding herewith a copy of the final report from Arcas Consulting Archeologists Ltd. entitled "Archaeological Impact Assessment, Proposed Expansion Project, Celgar Pulp Mill, Castlegar".

Our Branch accepts this report as meeting the requirements of an archaeological impact assessment under **B.C. Archaeological Impact Assessment Guidelines** and as a Stage II submission under **Major Project Review Process Guidelines.** It is recommended that the full archaeological report appear as an Appendix to the Stage II Report and that a synthesis of the archaeological report be included in the main body of the Stage II Report. The only outstanding requirement, which can be satisfactorily addressed in Stage III Permitting, is monitoring of excavations for the effluent treatment plant and the recovery and analysis of any archaeological remains inadvertently exposed by these excavations.

Should you have any questions concerning these comments, please call me at 356-1438.

R. A. Kenny
Senior Coordinator
Archaeology and Outdoor
Recreation Branch

RAK/ds
pc: David Parsons
MPSC Co-Chairperson
Policy and Planning Branch
Ministry of Environment

Province of
British Columbia

Ministry of
Municipal Affairs,
Recreation and Culture

Parliament Buildings
Victoria
British Columbia
V8V 1X4

D.S.B. 705.1

January 31, 1990

Mr. Frank Blasetti
Acting M.P.R.P. Coordinator
Regional Planning
and Infrastructure Branch
Ministry of Regional
and Economic Development
4th Floor, 712 Yates Street
Victoria, British Columbia
V8V 1X5

Dear Mr. Blasetti:

Re: Proposed Celgar Expansion

We have reviewed the socio-economic impact reports of the above project and our comments are as follows:

The project is a proposal for expansion of an existing mill located near Castlegar. The new expansion will create 30 new full-time jobs. In addition, it will create a large number of construction jobs between 1990 and 1992. This workforce will peak by the end of 1991 to 1,450, of which about 1,100 will be accommodated in company workcamp and the remainder will be hired locally.

The reports do not include any impact assessments of the workcamp on Castlegar and the area. It is our experience from similar projects elsewhere in the Province that although the nearby communities will be economically benefitted by the project, they will also be adversely impacted by the increase in road traffic, which will deteriorate municipal roads, increase the noise level and crime rates. In addition, it is expected that many migrant workers will choose to live with their families in town instead of in workcamp. This will create demand on housing as well as on many community services, including on the existing

.../2

medical facilities. Furthermore, we believe the project will generate many indirect jobs in the forestry and service industry. Impacts of these employments are required to be examined. We, therefore, suggest the proponent submit a detail and complete community impact report in Stage I.

Yours truly,

RGhosh.

Ray Ghosh
Senior Planner
Programs Section
Development Services Branch

RG/km

cc: M.P.R.P. Coordinator, Ministry of Environment

L.V. Luchin

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

MEMORANDUM

Frank Blasetti
A/MPRP Coordinator
Ministry of Regional
and Economic Development

January 15, 1990

52120-50/1

0084

PROPOSED CELGAR PULP MILL EXPANSION

In response to your request for comments on the above-noted project, pulp mill expansions have been identified as a very significant component of new electricity demand in British Columbia in the 1990s. As such, this Ministry wants to ensure that load displacement (i.e. cogeneration, conservation and on-site woodwaste electric generation) is thoroughly explored before utilities are forced to build expensive new generation resources to serve expanded industrial loads. Therefore, the proponent should address the following items in detail:

1. What are the existing mill's electricity requirements? How much of this is generated internally? How much will be bought from West Kootenay Power Ltd. (WKPL) and at what cost?

2. What are the proposed expanded mill's electricity requirements? How much of this will be generated on-site? How much will be bought from WKPL and at what cost?

3. Please indicate what feasibility studies or contacts with WKPL and other mills (for woodwaste) have been undertaken to examine on-site woodwaste or woodwaste/gas fired generation.

4. Section 7 does not indicate the volume of bark and scrap lumber that will be landfilled or incinerated without energy recovery. Although it is not within our jurisdiction, the Ministry of Environment will be interested in plans for woodwaste disposal. Please describe both the volume of woodwaste and the proposed disposal method.

...2/

Bob:
fyi/file(?)
FB

Thank you for this opportunity to comment.

Peter Ostergaard

Peter Ostergaard
Manager, Regulated Projects
Energy Policy Branch

cc: Gordon W. Douglas
Doug Dryden
Denise Mullen

Province of British Columbia
ENGINEERING AND INSPECTION BRANCH

Ministry of Energy, Mines and Petroleum Resources

MEMORANDUM

To: Frank Blasetti
Acting Coordinator
Major Project Steering Committee
c/o Ministry of Regional and
Economic Development
BUILDINGS

Date: February 22, 1990

File: 204-20/MPRP1

Re: Celgar Bleached Kraft Mill Expansion - December, 1989 Report

I have canvassed Branches in the Mineral Resources Division with respect to the above-captioned document. The Division has no concerns of a mineral development nature in connection with this project, and has no further need for involvement in review of the Celgar expansion.

Raymond L. Crook
Manager
Development Review and Approvals
Engineering and Inspection Branch
Mineral Resources Division

RLC:sf

cc: Ralph McGinn
Red Mellor
Denis Lieutard
Graeme Maclaren
Ron Smyth

Aldyn / Bob
fyi / file
FB

RECEIVED
[illegible] 27 1990
372
[illegible]

Province of British Columbia

PURCHASING COMMISSION

Ministry of Government
Management Services
and Minister
Responsible for
Women's Programs

Second Floor
4000 Seymour Place
Victoria
British Columbia
V8X 4Y3
Telephone: (604) 389-3300
Fax: (604) 387-5606 and 389-3370

January 29, 1990

Mr. Frank Blasetti
Acting MPRP Coordinator
Regional Planning & Infrastructure Branch
Ministry of Regional Development
712 Yates Street
Victoria, B.C.
V8V 1X5

[illegible]
JAN 30 1990
172
REGIONAL & RESOURCE
DEVELOPMENT [illegible]

RE: Celgar Pulp Company Bleached Kraft Mill Expansion Environmental Impact Assessment

Dear Mr. Blasetti:

We have reviewed the EVS & Cirrus Environmental Impact Assessment on the Celgar Pulp Co. Kraft Mill expansion and provide the following comments:

1. Celgar appears to intend to meet the current standard for levels of organo-chlorines (e.g. dioxins & furans). However it is not clear from the report whether due attention has been given to the trend set by the Federal Government to restrict organo-chlorine levels in paper by 1994.

Therefore, the Province might urge Celgar to consider designing the expansion with a capability to reduce organo-chlorines in its pulp as future legislation demands it.

2. While the report strictly addresses environmental impacts, the Purchasing Commission would welcome an opportunity to assist Celgar in finding local suppliers for the proposed expansion. The Commission hopes Celgar will consider designing the expansion to allow the supply contracts to be divided into smaller specialty contracts. Specialty contracts provide opportunities for maximizing the benefits of local suppliers.

3. Finally, from the general review of the Environmental Impact Assessment, the Ministry of Environment may wish to address the following issues:

- the current existence of levels of dioxin and furans in excess of recommended sport fish consumption levels;

- the potential to exceed "level A" Total Reduced Sulphur levels after the expansion; and
- the synergistic effect if other users increase pollution of the Columbia River.

If you have any questions please contact Noelle Reeve at 389-3384.

Sincerely

Raymond Chan

Raymond Chan
Director
Policy/Program Development

Province of
British Columbia

PURCHASING COMMISSION

Ministry of Government
Management Services
and Minister
Responsible for
Women's Programs

Second Floor
4000 Seymour Place
Victoria
British Columbia
V8X 4Y3
Telephone: (604) 389-3300
Fax: (604) 387-5806 and 389-3370

MR1/

February 7, 1990

267

Mr. Frank Blasetti
Acting MPRP Coordinator
Regional Planning & Infrastructure Branch
Ministry of Regional Development
712 Yates Street
Victoria, B.C.
V8V 1X5

RE: Pulp Mill Construction, Major Projects Review Process

Dear Mr. Blasetti,

For your information, I have attached a brief article from the business section of the February 3, 1990 edition of the Globe and Mail. This article reports the development of a pollution-free pulp mill by Millar Western Industries Ltd. of Edmonton, Alberta. Millar says it has designed a zero-effluent anti-pollution system for a proposed pulp mill at Meadow Lake, Saskatchewan.

The Purchasing Commission hopes that the Ministry of Regional Development will investigate the possibility of using this technology in the reconstruction of the Celgar Pulp Mill, which is currently the subject of the Major Projects Review Process.

Thank you for the opportunity to provide our input into the Major Projects Review Process.

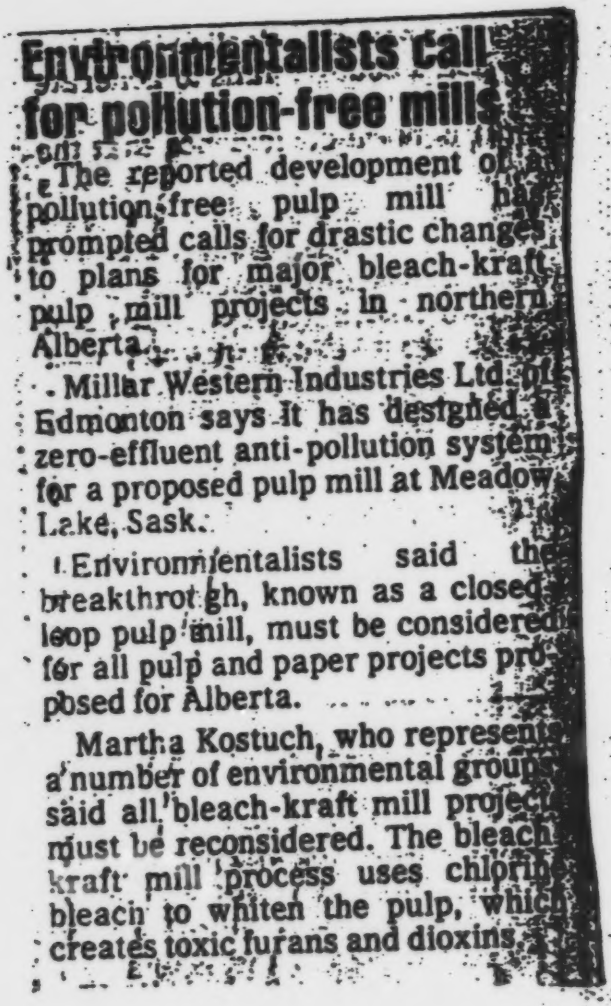
Sincerely,

Raymond Chan

Raymond Chan
Director
Policy/Program Development

cc: Mr. Rick Wilson
MPRP Coordinator
Ministry of Environment

BP /



Environmentalists call for pollution-free mills

The reported development of a pollution-free pulp mill has prompted calls for drastic changes to plans for major bleach-kraft pulp mill projects in northern Alberta.

Millar Western Industries Ltd. of Edmonton says it has designed a zero-effluent anti-pollution system for a proposed pulp mill at Meadow Lake, Sask.

Environmentalists said the breakthrough, known as a closed loop pulp mill, must be considered for all pulp and paper projects proposed for Alberta.

Martha Kostuch, who represents a number of environmental groups, said all bleach-kraft mill projects must be reconsidered. The bleach kraft mill process uses chlorine bleach to whiten the pulp, which creates toxic furans and dioxins.

Globe + Mail February 3, 1990
Report on Business

Province of
British Columbia

Ministry of
Transportation
and Highways

Telephone: 354-6319

Regional Director, Highways
Kootenays Region
4th Floor - 310 Ward Street
NELSON, British Columbia
V1L 5S4

PL3-20-2/89

February 16, 1990

MR3

Ministry of Regional and Economic Development
Regional Planning and Infrastructure Branch
Attention: MPRP Coordinator
4th Floor, 712 Yates Street
Victoria, BC V8V 1X5

317

AND

Ministry of Environment
Policy and Planning Branch
Environmental Assessment Section
Attention: MPRP Coordinator
777 Broughton Street
Victoria, BC V8V 1X5

Dear Sirs:

RE: PROPOSED CELGAR EXPANSION
- ENVIRONMENTAL IMPACT ASSESSMENT

We have reviewed Celgar's Environmental Impact Assessment as it relates to transportation. The only mention of transportation is contained in the companion report prepared by Stone-Consolidated Inc., under the heading "Infrastructure Requirements". The entire section consists of one page, presents no data and no analysis other than the statement that truck traffic will increase between 140% and 180%.

We are aware that Celgar has compiled a substantial amount of data related to truck movements and other transportation issues associated with the proposed expansion. Celgar has been very open in making such information available to the public, and a full discussion of transportation issues and concerns should be part of the impact assessment.

Specifically, we request that the environmental impact assessment be expanded to include:

1) an analysis of current and projected truck volumes, by type, cargo, origin, destination and routing;

...2/

ii) an analysis of the adequacy of the existing highway system to accommodate projected truck volumes and configurations in terms of highway geometry and pavements, traffic safety, ferry operations, and climatic conditions;

iii) an analysis of alternate modes of transporting logs and chips, namely by rail or water, in order to mitigate impacts on the highway system.

On behalf of the Ministry of Transportation and Highways, thank you for the opportunity to be involved in the Major Project Review Process. We trust that our requests will be considered constructive in advancing this project to the next stage of consideration.

Yours truly,

D. W. Barcham
Regional Manager, Planning

DWB/dc

Province of
British Columbia

Ministry of
Parks

Southern Interior Region
101, 1050 West Columbia Street
Kamloops
British Columbia
V2C 1L2
Telephone: (604) 828-4501
Fax: (604) 828-4737

RECEIVED
JAN 31 1990
184
REGIONAL & RESOURCE
DEVELOPMENT BRANCH

3-16-1-13

OUR FILE

YOUR FILE

Forward to:
Major Project Review
Process Co-ordinator
· Regional Development
· Ministry of Environment
G.Scott

90.01.18

RECEIVED
JAN 22 1990
PARK PROGRAMS BRANCH

Mr. Gil Scott
Ministry of ~~Parks~~
~~4000 Seymour~~ Place
~~Victoria~~, B.C.
V8V 1X5

Dear Gil:

Re: Proposed Celgar Expansion

Most of our concerns arise form the increase industrialization of the area and how this could affect people's perceptions in regard to its suitability for recreation. Specifically, these concerns are as follows:

1) Traffic: Chip truck traffic is projected to increase between 140% and 180%. We are concerned about problems such as traffic delays and the effects they will impose on tourist traffic in the vicinity of Castlegar. It is expected that deliveries of pulp logs by water may also increase. This growth in marine traffic may have negative impacts on recreational boating on Lower Arrow Lake.

2) Water Quality: Effluent from the mill is expected to be generally cleaner after expansion. However, nutrient effects, increased turbidity and colour changes from the effluent may combine to lead people to question how "safe" the water is, especially between the mill and the Kootenay River. If people perceive the water as being unsafe this could have adverse effects on the recreational fishery and water-oriented recreation downstream from the mill.

3) Air Quality: Although significant strides towards improving air quality are predicted, we still have concerns about emissions from the mill. Increased exhaust moisture, SO_2 and NO_x from the mill could lead to increased fog and smog given temperature inversions common in the valley. This could have adverse effects on recreational use of the area as people seek recreation areas that have less fog and smog.

Bob:
- fyi/circ.
JB

David Tudhope
David Tudhope
Regional Planning Assistant

cc: G.C. Rathbone

Province of British Columbia

Ministry of Education

School Facilities Branch
620 Superior Street
Victoria
British Columbia
V8V 2M4

January 8, 1990

CCSC

Mr. F. Blasetti
A/MPRP Coordinator
Ministry of Regional and
Economic Development
712 Yates Street
Victoria, B. C.
V8V 1X5

Dear Sir:

Re: Proposed Celgar Expansion

Thank you for forwarding the two reports relating to the proposed expansion of the Celgar plant in Castlegar, B.C.

Based on the information presented concerning the number of new full-time jobs and construction workers not usualy moving their families to construction sites, the impact of this expansion on the local school board's resources would appear to be easily managed.

Thank you once again.

Yours truly,

Tom A. Austin
Director, School Facilities

cc: D. Hibbins
K. Hunt
D. Jack

BOF
– copies for MPRP Steering Committee

Province of
British Columbia

Ministry of
Agriculture
and Fisheries

MEMORANDUM

February 19, 1990

347

Mr. Robert Steele
Research Officer
Regional Planning and Infrastructure Branch
Ministry of Regional and Economic Development
712 Yates Street
Victoria, British Columbia
V8V 1X5

Celgar Pulp Mill Modernization/Expansion

I would like to thank you for providing my ministry with a copy of the Environmental Impact Assessment for the Celgar Pulp Co. expansion. This report was referred to personnel in the Aquaculture and Commercial Fisheries Branch for review. Based on their review of the impact assessment, it would appear that the expansion/modernization plans will improve habitat quality in the effluent receiving waters near the pulp mill.

The report, however, does not provide an assessment of the impacts of pulp waste water discharges on irrigation agriculture. Licensed water withdrawal figures shown in tables 5.2 and 5.3 of the report identify forage crops as a major user of water for irrigation. Specifically, daily water consumption for irrigation totals approximately 22 percent of withdrawals from the Columbia River (Keenleyside Dam to Birchbank) and 45 percent from the Columbia River (Birchbank to the Canada/United States border). It is estimated that over 400 hectares of forage crops are irrigated from the Columbia River in the above areas.

This ministry is concerned with the effects of the bio-accumulation of chlorinated organic compounds on agricultural soils and the impacts associated with food safety. The Canadian Water Quality Guidelines (1987) do not prescribe concentrations of these compounds, including dioxins and furans.

It is recommended that an assessment be undertaken to identify and evaluate the extent and effects of the Celgar Pulp Mill waste water discharges on agriculture for the areas between Keenleyside Dam and the Canada/United States border. In addition, a program should be initiated to monitor the effluent quality to ensure the agricultural environment is protected.

.../2

The consultants have made a number of recommendations as to future monitoring programs to assess the impact of the expansion/modernization plan. We endorse these recommendations and believe they should be implemented in consultation with personnel from the Ministry of Environment.

Al Sakalauskas
Assistant Deputy Minister
Policy and Administration

Celgar Pulp Company: Bleached Kraft Mill Expansion

Background:

The Celgar Pulp mill is located in Castlegar, British Columbia seven kilometers upstream of the confluence of the Columbia and Kootenay Rivers. Bleached Kraft Pulp mills produce a variety of waste emissions including Absorbable Organic Halides (AOX). Included in the AOX category are toxic furan and dioxin compounds which bio-accumulate in freshwater organisms. The expansion of the Celgar Plant, therefore, has implications for water quality on the Columbia River.

In 1988, in British Columbia, Environment Canada and Fisheries and Oceans began a program of sampling for dioxins and furans in the vicinity of pulp and paper mills. Fish and river bed sediment samples were collected upstream and downstream of ten pulp mills in the interior of British Columbia and analyzed for dioxins and furans. The highest levels were found downstream of mills on the Fraser, Thompson and Columbia Rivers.

Human health concerns have focused on the consumption of fish and the possible health effects of consumption of contaminated drinking water. As a result of the sampling program, the provincial government issued a health warning in May 1989 to advise the public that drinking water is safe but consumption of fish near the most affected mills should be moderated. The Ministry of Environment, with information provided by the Ministry of Agriculture and Fisheries, is formulating sampling programs to address crops and livestock irrigated with water from the affected rivers.

The impact assessment indicates that AOX discharge should be reduced with plant conversion to newer processing technologies. The total amount of all other waste emissions from this plant are predicted to be reduced from present levels with the exception of total suspended solids (TSS) and gaseous sulphur compounds. The TSS content of the liquid effluent will contain less wood fiber and more soluble organics and, therefore, should reduce the extent of the benthic fiber mat developed near the waste water diffuser pipe.

Recommendations:

The expansion of this mill should reduce chlorinated dioxins and furans to below current detection limits. This is a positive step as preliminary testing of fish have indicated that dioxin and furan levels are significant in fish in the Columbia River. The expansion will reduce the absolute amounts of most other waste emissions and therefore **should be endorsed.**

The impact assessment report makes several recommendations concerning environment and effluent monitoring requirements at this site. All of these recommendations are valid and would help further characterize the mill impact. In particular, the use of sentinel organisms such as clams and longnose or large-scale suckers to monitor the accumulation of AOX in biota is a concept which should be developed and implemented in consultation with personnel from the Ministry of Environment.

Province of British Columbia
Ministry of Social Services and Housing
CORPORATE SERVICES DIVISION

MEMORANDUM

To:

Mr. Frank Blasetti
Acting MPRP Coordinator
Ministry of Regional
and Economic Development
712 Yates Street
Victoria, British Columbia
V8V 1X5

Date: January 24, 1990

149

Re: Proposed Celgar Expansion

I am pleased to have an opportunity to respond to both the reports I received: Bleached Kraft Mill Expansion Environmental Impact Assessment and Celgar Pulp Company Modernization and Expansion Project.

My concerns and interest in the upgrading and expansion of the existing kraft pulp mill in Castlegar relate primarily to the socio-economic impacts. I note that you foresee "incremental employment opportunities in the logging, transportation and service industries" and if the modernization and expansion is fully implemented, you expect an increase of at best 30 people to the current 380 employees. As the principal employer in the Castlegar region, the expansion would in fact continue to provide opportunities for secure employment. I would also anticipate a number of new jobs in both the construction of the expanded mill and in the road system to service the mill.

Obviously this Ministry is critically interested in any new employment opportunities for employable people who are currently receiving provincial Income Assistance in the province.

Assisting our clients to regain financial independence from income assistance is one of our primary goals. To assist in this endeavour, we have Rehabilitation Officers throughout British Columbia. In the Castlegar area, the Rehabilitation Officer is Ms. Georgiann Klemmer. Her address is Ministry of Social Services and Housing, 930 Rossland Avenue, Trail, British Columbia, V1R 3N6. Her telphone number is 364-0550.

/...2

I request that Ms. Klemmer as the local Ministry Rehabilitation Officer be contacted as a source to identify and refer people for the positions created by this project.

I have, as well, one other concern related to employment within this project. There are limited employment opportunities available, however, I strongly suggest that every effort be made to secure local employees. If the company widely promotes the opportunities for employment in the construction and expansion of the mill, we will have an influx of unskilled persons from around the province coming to Castlegar thinking there are substantial new employment opportunities. Hopefully, some caution will be exercised to avoid widescale advertising for employment so as to prevent people from arriving in the area without a confirmed job.

Finally, I request that serious consideration be given by Celgar to employing some percentage of their employees from the local Native Indian population. As I'm sure you are aware, Native communities have been significantly under-represented in the share of economic wealth of this province. I suggest a proactive approach be implemented to ensure persons of Native origin are given a share of the employment opportunities contained in this project.

To summarize, the following are my suggestions in relation to the socio-economic impacts of the Proposed Celgar Expansion:

1) That the Ministry of Social Services and Housing be a primary referral source for the local labour supply needed within the scope of the project. The contact person is Georgiann Klemmer at 364-0550;

2) That some caution be exercised in advertising the creation of employment by this project and that the local labour supply for skilled and unskilled workers be exhausted prior to looking outside the local community, and;

/...3

3) That a proactive-effort be made by the company to offer employment to local Native residents.

Thank you for the opportunity to comment on this project.

Fern Jeffries
Director
Corporate Services

c.c: Mr. Larry Ohlmann, Regional Director, Region F

Mr. Lou Violini, Area Manager,
I.A./E.I.P., West Kootenays Office (F4A)

Ms. Georgiann Klemmer, Rehabilitation Officer,
I.A./E.I.P. Trail/Castlegar Office (F42)

Province of
British Columbia
Ministry of
Health

MEMORANDUM

Mr. F. Blasetti
Acting MPRP coordinator
Ministry of Regional and
Economic Development
712 Yates Street
Victoria, B.C.
V8V 1X5

February 6, 1990

Dear Mr. Blasetti:

258

Re: Proposed Celgar Expansion

The Ministry of Health has reviewed the document entitled, "Bleached Kraft Mill Expansion Environmental Impact Assessment", December 1989.

We request the Steering Committee address the following concerns.

1. Sulphur dioxide emissions may exceed the Level A one-hour ambient air quality objective. This event in combination with the sulphur dioxide emissions from the Cominco plant at Trail would compromise the objective in achieving the Level A standard. The 20 mile corridor between the subject mill and Cominco comprises communities whose residents could experience adverse health effects of cumulative air emissions.

2. The development of air quality modelling predictors should include the effects of sulphur dioxide accumulations from Trail. Air inversion conditions in the area between Trail and Castlegar and the total resultant sulphur dioxide levels warrant a review of the combined impact rather than that from only Castlegar (Celgar). Similarly, water quality modelling should address the impact of a proposed dam at Murphy Creek. The lake, so created, will probably change the water quality downstream, south of Genelle.

3. The incineration of dewatered sludge residue could produce dioxins and furans from organochloride compounds if there are insufferent combustion temperatures and controls.

4. Suspended solid loading from mill effluent will increase by 81 percent. This may have an adverse affect on downstream water quality. Will the water quality comply with the Canadian Drinking Water Standards? Clarification is requested on this potential problem.

.../2

5. Other major events may influence the Columbia River flows. There is a proposed Brilliant Canal (upstream from confluence of Columbia and Kootenay Rivers) and a dam at Murphy Creek (midway between Castlegar and Trail). Tadanac, Warfield and Cominco use the Columbia River for their drinking water. The city of Trail has a water licence and may have a long term domestic need for Columbia River water. Therefore, the Celgar project should be reviewed with a consideration for these future changes.

6. Construction of the Murphy dam will create an 11 mile long lake which will be the receiving water for Celgar wastes.

   a. What affect will this have on the potability of the water for downstream users?
   b. What physical and chemical changes would occur due to this impoundment and altered flow rate?
   c. What affect does the impoundment have on the ability of the lake water to recharge itself.
   d. Nutrient loading to this lake from Celgar Wastes may effect a change in the water's flora and plant propagation, thereby affecting water quality.
   e. Will industrial wastes from the new mill in addition to those wastes from municipal and industrial domestic sewage effluent and storm sewer drains adversely affect the river water quality?

7. The new mill will have an increased demand for raw materials which will significantly increase vehicular traffic in the Castlegar environs. Has Celgar identified the potential problems that may result?

8. To deal with the short and long term effects identified in (1) above, the Ministry of Health requests that Celgar agree to the following condition at the permitting stage.

   "Celgar shall establish before (date to be determined) four air monitoring stations and operated for and in cooperation with and to the satisfaction of the Medical Health Officer. The four air monitoring stations shall be at locations determined by the Medical Health Officer to monitor those substances determined by the Medical Health Officer (Initial monitoring will include: total reduced sulphur and sulphur dioxide). The Medical Health Officer may require other substances to be monitored at the four stations.

.../3

Please keep me advised of the status of this project and the opportunity to participate in matters of public health and safety.

Sincerely,

John J Philion

John J. Philion
Research Officer
Research and Evaluation
Policy, Planning and Legislation

JJP/tls

cc: H. Richards, Provincial Health Officer
N. Ames, Medical Health Officer
B. de Faye, Director of Policy
G. Curtis, Executive Director, Policy, Planning & Legislation
G. Penner, Manager, Public Health Protection

Province of British Columbia
Ministry of Native Affairs

MEMORANDUM

To: Mr Frank Blasetti
Acting MPRP Coordinator
Ministry of Regional
and Economic Development

January 12, 1990

8876

Re: Proposed Celgar Expansion

This will reply to your memorandum of December 28, 1989 on the above mentioned topic.

From the material provided, it appears that there are few Native interests in the Castlegar region, where Celgar plans to update its Kraft pulp mill.

However, the comprehensive land claim of the Kootenay Indian Area Council borders on Castlegar, and the Council may have some concerns about the proposed mill expansion.

Celgar Pulp Company may therefore wish to consult the Kootenay Indian Area Council about possible effects from the mill.

Nicholas May

Nicholas P. May
Manager
Natural Resource Management

cc: Ministry of Environment
MPRP Coordinator
Policy and Planning Branch
Environmental Assessment Section

LDB:cw

APPENDIX F

Federal Government Agency Comments

Environment Canada Environnement Canada

Water Quality Branch
Inland Waters
Pacific & Yukon Region
Conservation and Protection
502-1001 West Pender Street
Vancouver, B.C.
V6E 2M9

Your file Votre référence

Our file Notre référence 7572-2

March 9, 1990

Mr. D. Parsons
Co-Chairman
Major Project Review Steering Committee
Ministry of Environment
777 Broughton Street, 3rd Floor
Victoria, B.C.
V8V 1X5

Dear Mr. Parsons:

Re: **Environmental Impact Assessment (E.I.A.) for Celgar Pulp Mill Expansion**

The Company has provided two documents for review:

(1) Celgar Pulp Company Modernization and Expansion Project (December 1989),

(2) Celgar Pulp Company Bleached Kraft Expansion Environmental Impact Assessment (December 1989).

These reports have been reviewed by Environment Canada (Environmental Protection, Atmospheric Environment Service, Canadian Wildlife Service and Inland Waters), Indian and Northern Affairs Canada and Health and Welfare Canada. The reports have been reviewed by the respective agencies with respect to issues and responsibilities within federal jurisdiction. Federal interests include requirements under the Fisheries Act, the Federal Pulp and Paper Effluent Regulations, the Canada-U.S. Boundary Waters Treaty, the Navigable Waters Protection Act, the Canadian Environmental Protection Act, the Canadian Food and Drugs Act, the Canada Wildlife Act, and the Migratory Birds Convention Act.

As you know this project has an impact on areas of federal responsibility pursuant to the Acts mentioned above. Therefore, a federal Environment Assessment Review Process (EARP) could be applied. However, a decision on this has yet to be reached. A comprehensive review of the project under the provincial Major Project Review Process, which incorporates federal concerns, with adequate public consultation and resolution of all environmental issues raised by the reviewing parties, could also be used by federal agencies as a basis for meeting any identified EARP responsibilities. We would prefer to work through the Provincial review system, and will make every effort towards a successful review.

These documents were also forwarded to the relevant United States state and federal agencies for review. The U.S. Environmental Protection Agency, U.S. National Park Service as well as the Washington State Department of Ecology provided comments and expressed concerns. Additionally, the Colville Confederated Tribes and Lake Roosevelt Forum have already provided comments (copy attached) to you directly.

We would also like to draw to your attention the mechanism available to both the U.S. and Canadian governments if transboundary concerns are not satisfactorily addressed in the review process. A joint application may be made by the respective governments for resolution of the transboundary issues. This process may then be referred to the International Joint Commission (IJC) for consideration under a formal reference. This reference process can be extremely detailed and lengthy, as evidenced by the IJC reference of the Sage Creek Coal Project on the transboundary Flathead River in British Columbia. Therefore, every effort should be made to identify and resolve issues of special importance to U.S. agencies and interest groups during the present review.

Based on assessments conducted by Canadian federal and United States state and federal agencies, we feel that the abovenamed reports more than fulfil the requirements of a Prospectus but fall short of what is expected of Stage I under the Major Project Review Process. There is no doubt that the proposal to replace the existing process with new pulping and bleaching technology together with biological treatment will reduce the discharges of many of the environmental contaminants, but there are still outstanding concerns to be addressed. For this reason we recommend that the project proceed to Stage I as per the Major Project Review Process Guidelines. In order to evaluate the project further, these concerns must be addressed in the Stage I report.

The following is a summary of the concerns that were expressed by the agencies who reviewed the two documents:

(1) There is little discussion on the environmental impact of discharges/emissions from the expanded mill. Discussions on environmental impact should be more detailed, especially with regard to discharges such as nitrogen and total suspended solids (TSS) which will increase by 1,200% and 81%, respectively over existing levels. Please note that there are data available on nitrogen and phosphorus in the Columbia River through the Canada/B.C. Water Quality Monitoring Agreement. Additionally, there should be a discussion as to whether or not the expanded mill effluent will exert sublethal or chronic effects on the aquatic organisms in the receiving waters of the Columbia River.

(2) The claims in the Prospectus for effluent quality should be documented.

(3) The possibility that most of the hydrophobic toxic organic compounds will be associated with the biosolids should be discussed.

(4) The impact of a 1,200% increase in nitrogen loading to the Columbia River should be assessed. Due to the large input of P from Cominco at Trail, the Columbia River at Waneta is probably nitrogen limited. The effect of this increase on the Columbia River at the border should be discussed.

(5) The expanded mill will increase SO_2 and NO_x emissions from 26Kt/yr to 959 kt/yr and 463 kt/yr to 922 kt/yr, respectively. The potential acid precipitation is of concern. The feasibility of using a scrubbing system to reduce these emissions should be discussed.

(6) An assessment on the impact of filling in some of the foreshore areas adjacent to the mill should be provided.

(7) The transport of biosolids across the international boundary is of concern. The impact of these biosolids on the border reach of the Columbia River should be assessed.

(8) The hydraulics of the Columbia River from the Hugh Keenleyside Dam to the confluence of the Kootenay River, especially the formation and breakdown of the hydraulic dam, should be understood and the distance required for complete mixing under various flow conditions should be provided. A scenario should be developed which describes the behavior of the Celgar effluent in the Columbia River, should the Murphy Creek Dam project proceed.

(9) Ground water/surface water relationships for both the landfill site and the biotreatment ponds should be determined to ensure there will be no leaching from these facilities directly into the Columbia River.

(10) The receiving water objectives given in Table 5.5 of the Prospectus are no longer applicable. The Province of B.C. is currently developing water quality objectives for the Columbia River upstream of Birchbank. Until Water Quality Objectives are finalized, predicted levels of specific variables should be compared with major criteria documents such as the C.C.M.E. (formerly C.C.R.E.M.) guidelines and the provincial working criteria documents. At the international boundary, predicted water quality conditions should be compared with Washington State water quality standards for the Columbia River (Water Quality Standards for Surface Waters of the State of Washington, 1988.).

(11) More information is required on chlorinated organic compounds, including concentrations in landfill wastes, water, sediments and biota. This should be done at a background station upstream of the mill, at a site downstream where complete mixing occurs but upstream of the Kootenay River confluence, and at a site upstream of the international boundary.

(12) Data should be supplied to substantiate the proponents conclusions regarding the generation of, and impact from, landfill leachates.

(13) In order to properly assess any impact the development may have on fisheries resources, it is imperative that a current resource assessment be made. This should include feeding habits, migration, spawning and rearing.

(14) An hydrogeologist should carry out a detailed groundwater investigation of the landfill and mill properties. The report should address local groundwater flow directions, flow rates, contaminant concentrations, contaminant flow directions, contaminant flow rates, landfilling practices, health risks, environmental risks, and remedial options (if required).

(15) It is proposed by the proponent to discharge leachates to local groundwaters. Page 178 states "The mill will continue to collect chip pile and hog fuel leachate and direct it in a manner to filter through the soil to groundwater, and avoid any direct releases to surface waters." The followng information is required: (1) The attenuation of leachates occuring in the sand and gravels. (2) The impacts of leachate on groundwater quality. (3) The volumes being discharged to the landfill daily. (4) The daily chemical loading into the river via groundwater. (5) The effect of continual discharge on subsurface permeabilities.

(16) The feasibility of collecting and piping the landfill leachates and leachates from chips and hog fuel to the biotreatment ponds should be discussed.

(17) The environmental impact of SO_2 and NO_x emissions should be assessed based on loadings to the environment as a deposition.

(18) When increases in NO_x are anticipated, chemical conditions in the atmosphere may produce further pollutants of concern. This issue should be addressed with a photochemical model.

(19) It is proposed that effluent sludge will be burned in boilers. The assessment of the impacts of this practice should be documented.

(20) The proponent should fill the data gaps identified in section 8 of the Prospectus and submit this information in Stage I, specifically point 1 (water quality measurements in the Columbia River in the vicinity of the mill and the downstream receiving environment) and point 3 (regular and detailed study of the effluent characteristics including but not limited to determination of levels of chlorinated organics, resin acids, sulphides and colour, and their effects on resident biota).

Various long term monitoring requirements have been submitted by federal and U.S. agencies, as can be seen in the attached correspondence. These requirements will be discussed at a later date. Please be advised that the federal Pulp and Paper Effluent Regulations, currently being developed, will include a required monitoring program.

In addition, Health and Welfare Canada submitted general comments with respect to the potential impact of pulp mill expansion on human food systems.

They are as follows:

1) All components of the effluent, air emissions and solid wastes from the pulp mill should be determined. Emphasis should be placed on those substances associated with this type of industrial operation and of most concern from the standpoint of potential hazard to human health (e.g. organochlorine compounds, polycyclic aromatic hydrocarbons and heavy metals).

2) The levels of each of these substances in the local food chain should be determined. (The local food chain would include fish from the area, crops/edible plants grown in the surrounding area, and domestic animals/wildlife raised or captured for food purposes). The levels observed would reflect the background levels of these substances in the environment, as well as releases to date from the pulp mill and other possible sources in the area.

3) An estimate of the potential impact of any pulp mill construction or expansion on the levels of contaminants released into the environment, and the subsequent impact on foods obtained from the vicinity of the pulp mill should be determined.

Detailed explanation of the above comments, plus additional concerns and information requirements can be found in the attached comments of the followng individual agencies. These comments should be given serious consideration in the preparation of the Stage I submission.

Atmospheric Environment Service, Environment Canada,
Canadian Wildlife Service, Environment Canada,
Environmental Protection. Environment Canada,
Inland Waters, Environment Canada,
Health Protection Branch, Health and Welfare Canada,
Medical Services Branch, Health and Welfare Canada,
Indian and Northern Affairs Canada,
Fisheries and Oceans Canada,
U.S. E.P.A.,
U.S. National Parks Service,
Washington State Dept. of Ecology.

Thank you for giving us an opportunity to review this submission. Your continued cooperation is appreciated. If further information is required, please contact me at 666-8000.

F.T.S. Mah
Toxic Chemicals Co-ordinator

c.c. M. Ito, Environmental Protection
S. Samis, Fisheries and Oceans Canada
S. Anderson, Indian and Northern Affairs Canada
L. Retfalvi, Canadian Wildlife Service
B. Thomson, Atmospheric Environment Service
J. Hirsch, Health and Welfare Canada
R. Lawrence, Health and Welfare Canada
R. Albright, U.S. E.P.A.
C. Pharo, Water Planning & Management
G. Kuiper, Superintendent, Coulee Dam National Recreation Area
C. Odegaard, U.S. National Park Service
C. Nuechterlein, Washington State Dept. of Ecology
V. Niemela, Inland Waters
J. Millen, Chairman, Environmental Assessment Coordinating Committee
L. Churchland, Water Quality Branch
P. Scott, FEARO
V. Bartnik, Water Planning & Management
H. Liebscher, Water Planning & Management

[redacted]

Colville Confederated Tribes
P.O. Box 150 · Nespelem, Washington 99155 (509) 634-4711

February 16, 1990

David Parsons
Policy and Planning Branch
BC Ministry of Environment
777 Broughton Street
Victoria, B.C. V8V 1X5

RE: CELGAR PULP MILL AND LAKE ROOSEVELT WATER QUALITY

Dear Mr. Parsons:

It was with sadness and regret that we today read reports of deadly chemicals in Lake Roosevelt fish and water. The Columbia River has served as a mainstay of tribal culture and its food source since time immemorial. Our historic salmon fishery was destroyed by the construction of Grand Coulee Dam (as was the Canadian fishery).

Looking towards improving the future for our tribal members and the local economy, the Confederated Tribes of the Colville Reservation has invested millions of dollars and countless hours of time in our Roosevelt recreation enterprises (houseboats, and marinas) and in improving the fishery in Lake Roosevelt.

For these reasons - for future generations - the Tribes intends to remain in the forefront in addressing water quality problems which affect Lake Roosevelt. Please work with our tribal Environmental Trust Department and our Fish and Wildlife Department, together with the "Lake Roosevelt Water Quality Committee." I support the comments they have sent regarding the Celgar Mill. This project must receive more review before it is approved.

Sincerely,

Jude C. Stensgar

Jude C. Stensgar, Chairman
Colville Confederated Tribes

cc: Fred Mah ✓

Colville Confederated Tribes
P.O. Box 150 · Nespelem, Washington 99155 (509) 634-4711

February 16, 1990

David Parsons
Policy and Planning Branch
BC Ministry of Environment
777 Broughton Street
Victoria, B.C. V8V 1X5

RE: COMMENTS ON THE CELGAR PULP MILL EXPANSION ENVIRONMENTAL IMPACT ASSESSMENT

Dear Mr. Parsons:

On behalf of the Lake Roosevelt Forum, the Lake Roosevelt Water Quality Committee, and the Confederated Tribes of the Colville Reservation (Tribes) I want to thank the British Columbia Ministry of Environment and Environment Canada personnel for making an excellent presentation to the Lake Roosevelt Forum on January 25th. I also want to thank B.C. Environment for helping us obtain information on Columbia River Water Quality.

The Lake Roosevelt Water Quality Committee is a group of people representing tribes and government agencies with a common interest in Lake Roosevelt water quality. We meet with and obtain input form the Lake Roosevelt Forum, albeit we function more or less independently. The Committee is composed of a representative from the Upper Columbia River Counties (Marie Bremner), the National Park Service (John Haller), the Spokane Tribes (Larry Goodrow), the Colville Confederated Tribes (myself), the U.S. Bureau of Reclamation (Jim Romero), the Bureau of Indian Affairs (John Rydzik), the Washington State Department of Ecology (Phil KauzLoric), Washington State University (Ed Broch), and private citizens Win Self and Jack Tentor.

These also constitute the official comments of the Tribes. I was the principal author of these comments, but I did not review the entire EIA. If you have any questions, please contact me and I can, if necessary, direct you to the person who reviewed the report section in question.

We did not confine our comments to impacts in the United States only, although our major focus of concern is Lake Roosevelt.

BACKGROUND AND GENERAL COMMENTS:

Before making any assessments of the environmental impact of the proposed new pulp mill it must be understood that the present Celgar pulp mill must come into compliance with current water quality standards or be shut down. If it were in compliance, the percentage reductions in effluent levels would be dramatically less. The Bleached Kraft Mill Expansion report uses comparisons with a very dirty mill to make the proposed reductions in effluent from the new mill appear higher than they otherwise would appear.

Of major concern to us is the lack of consideration for the enormous damage to Lake Roosevelt and the American Upper Columbia ecosystem which has already occurred due to the discharge of essentially untreated Kraft pulp mill effluent over a 30 year period. As a result enormous amounts of persistent toxins from pulp mill wastes, as well as from the Cominco lead and zinc smelter and the Cominco fertilizer operation, have accumulated in the sediments of Lake Roosevelt and in the American Upper Columbia River. Lake Roosevelt must be viewed as an extremely fragile ecosystem whose assimilative capacity for toxins has been exceeded.

Any toxins added to the Columbia River must be kept to absolute minimum levels within stringent water quality standards until comprehensive studies assessing the ecological status of the extremely important water resource have been completed. The tremendous number and quantity of toxins discharged into the Canadian Lower Columbia and the American Upper Columbia and Lake Roosevelt raises the likelihood of synergistic effects on the biota. Therefore, even conservative water quality standards may be too high for the system to assimilate.

Most importantly, the proposed change calls for a doubling of pulp production. Effluent reductions in the proposal are based on percent reduction per kilogram of dry pulp produced. However, doubling of production means that there will be an increase in most toxins over current levels. The Lake Roosevelt ecosystem will be subjected to even greater loadings of persistent toxins added to the already intolerable current levels. Again it must be acknowledged that percentage reductions of effluent are compared against the current excessive levels which have been allowed by the Ministry of the Environment through variances. In addition all Canadian calculations on water quality standards are based on a riverine system whereas the reality is that below the international border the Columbia becomes a lentic (lake) system with a much lower assimilative capacity.

Recently published evidence of high levels of dioxan (2,3,7,8 TCDD) in fish in both the Canadian Lower Columbia and in the American Upper Columbia and Lake Roosevelt establishes the Celgar pulp mill as the source.

The extremely high toxicity of dioxin along with its accumulation in Lake Roosevelt sediments mandates a zero discharge of dioxin. Any new mill design must produce dioxin free effluent. Therefore, alternative technologies to the Kraft bleached mill process should be required.

The proposal for the new mill should include future modifications that would result in the goal of zero discharge of all persistent toxics to be achieved within a specified target date. In addition immediate steps should be taken to halt discharge of dioxins to the Columbia River by the present Celgar pulp mill.

Past practices in both the U.S. and Canada has been to continue to allow discharges of toxics while we "study" the problem. If continued, this course of inaction will lead to toxic waste clean-up sites in the beds of rivers and lakes. Future generations will be saddled with astronomical clean up bills. Canada and the U.S. should work together to specify a goal of zero discharge of persistent toxics. This is the only real solution.

SPECIFIC COMMENTS:

PP 13,25,30: A 24 hour emergency spill pond is referenced, however, it is unclear from the text whether this will be sufficient for the entire plant. Will this hold all effluent under a shut down emergency? Will the pond be lined with impermeable material? Will there be a spill emergency contingency plan at the plant?

PP 19,21: Tables 3.1 and 3.2 do not seem to correspond. Multiplying kg/ADt by ADMt/d does not equal the Table 3.1 figures.

VARIANCES

P 18: All stated environmental quality objectives must be made legally binding. It is only the permits issued by the Ministry of Environment that ensure conformity to water quality standards. The long history of variances by the British Columbia Ministry of the Environment requires assurances that water quality standards once established will be enforced. "Economic variances" should be eliminated. When a discharger is not in compliance fines should be levied and a plan immediately implemented to correct the situation. Giving the discharger a variance is unfair to all discharges who are in compliance.

WATER QUALITY COMMENTS:

General comment: The report contains no comparisons with other pulp mills regarding waste treatment system performance. Such a comparison would help the reader determine the relative efficacy of different systems.

P. 26: A 90% reduction in BOD from biological treatment sounds very high. Have other plants achieved this level from a similar process?

P. 29: Give the "no detectable change" standard. We recommend monitoring effluent discharge temperature prior to approving the system.

P. 107: Table 5.4 should list sturgeon to agree with text.

P.132: Temperature effects studies should be conducted when river water/effluent temperature difference is greatest.

WOOD FIBERS, BIOSOLIDS, TSS

PP 129,130,140,144,146,150,157: Fiber and suspended solid discharges, together with the numerous organic compounds associated with these is a major concern. It is discouraging that total suspended solids in the mill effluent will increase 81% over current levels. This is clearly a step backwards. 12,000 kg/day of solids (over 4800 std.tons/yr), is an enormous and intolerableamount of material being released into the river, much of which will eventually end up in Lake Roosevelt. We have no idea of the quantities or fate of these materials when they reach the U.S. portion of the river (Lake Roosevelt).

The wood fiber waste must contain organochlorine compounds. It is unclear from the test how fiber effluent can be significantly increased while organochlorines decrease. The report should contain a detailed analysis of wood fiber constituent compounds and other (AOx) compounds, and include an analysis of where the different compounds are going.

Fibers and biosolids should be settled or filtered out of the waste stream. The quantity of these materials reaching the river should be reduced by two orders of magnitude, or, to some level that can realistically be assimilated by the ecosystem. Until this happens, we can only assume that Lake Roosevelt will serve as a sump for vast quanities of complex organic materials, the effects of which are unknown.

The report should contain estimates of how much of this material has been transported into the U.S. in the past as well as projections for transport under proposed future operations. The text and mill flow sheet do not indicate an activated sludge process prior to the initial clarifier. This would help reduce the solids volume.

Is the waste material going to be treated with nutrients to aid microbial decompositions? The text does not discuss this.

LOG STORAGE

P.155: It is unclear from the text whether log storage is included in wood waste fiber, biosolids, TSS, and BOD estimates. A return to river log storage will increase the fiber level waste emissions. An alternative to this should be found. Leachate from the mill yard should be collected and treated prior to discharge. Groundwater in the vicinity of the Westar and China landfills should be monitored for contamination (see solid waste comments following).

CHLORINATED DIOXIN AND FURANS

P.160: Chlorinated dioxins and furans are, of course a vital concern. Plans to reduce these compounds in the waste stream below detection limits is commendable. The sampling points within the processing system need to be established. The below detection limit standard should be specified to occur before the bleach plant waste is mixed with other wastes.

ABSORBABLE ORGANIC HALIDES

Discharge of effluent from the mill contains chlorinated dibenzodioxins, dibenzofurans, chlorinated phenolics and resin acids and possible 3,000 additional types organochlorine compounds.

P 157: The fact that 1800kg/day of AOX (724 standard ton/yr) to be discharged to the river is alarming. This constitutes an enormous amount of toxic material, even given the short half-lives of some of the concentrates. The report should contain estimates of the quantity of this material that has been transported into the U.S. Columbia River from past operations as well as projections for further emissions transport. Proposed AOX emissions should be reduced by two orders of magnitude to avoid further buildup of these materials in Lake Roosevelt. Additional sediment and bioaccumulation studies are needed to determine the effect of these materials on the ecosystem; to determine the quantities which can be assimilated by the environment.

P 163 Population fish consumption and epidemiologic studies should be commenced for the people who fish in the Celgar area as soon as possible. The bioaccumulation of the above compounds may make the fish unsafe to consume and produce lethal/sublethal effects to aquatic organisms. The sampling of the above toxic compounds in sediment, water and aquatic organisms is inadequate in terms of species diversity and quantity of samples.

It is apparent that the concentrations will be greater closer to the mill and less at farther distances downstream, however fish species such as walleye, whitefish, kokanee and rainbow can migrate considerable distances within a river system (i.e. fish near mill with greater concentrations may end up in the United States).

COLOUR

It is unclear from the text whether there is a water quality standard for colour, when colour is expressed as mgCoPt/l equivalent in a chart it would be helpful to readers if it was pointed out that, although expressed as mass per unit volume, colour figures do not actually represent material in the waste stream, but rather an equivalency with a known standard dilution.

AIR POLLUTION

Throughout the report, there is no discussion of overall wind currents or direction, other than extremely localized wind conditions (maximum distance discussed is to Trail, B.C.) (p.57). On p.68, it does state "drainage flows down the Pass Creek and into the Columbia Valley are common." A map showing what this area entails would be most helpful. On p.84, it concludes "since the winds in the Columbia Valley west of Castlegar tend to follow the contours of the valley, the long-term impacts to be expected from a mill there will be east, southeast and west of the mill." It never states how far in these directions the pollution might be carried. These deficiencies in the report make it impossible to evaluate the environmental impact of the air pollution in areas away from the mill.

SULFUR DIOXIDE

Although the EIS states (p. 50) "all ambient air quality levels in this report are well below the specified maximum tolerable levels," and "the expanded mill is designed to meet the Level A objectives (p. 42) this does not hold true for sulfur dioxide. The projected overall area maximum value for SO2, averaged over a 1-hour period, is 818.22 ug/m3. Level A (maximum desirable) is 450 ug/m3, and level B ("maximum acceptable") is 900 ug/m3.

Maximum desirable and maximum acceptable levels are set by Environment Canada. Maximum acceptable is defined (on pg. 50) as intended to provide adequate protection against....(environmental or health) effects. It represents the realistic objective today for all parts of Canada (it is not stated whether this is the opinion of Environment Canada or Celgar.) When this level is exceeded, control action by a regulatory agency is indicated.

The document then goes on to state that the British Columbia Ministry of Environment Pollution Control Objectives for the forest products industry also contain objectives for ambient air quality. These objectives, which are designated Level A and Level B, are "generally consistent with the Maximum Desirable and Maximum Acceptable national air quality objectives established by Environment Canada." It does not give a definition of Level A or Level B, as defined by the B.C. Ministry of Environment, leaving it unclear as to whether these Levels have specific definition.

However, the sulfur dioxide level of 818 is obviously close to the cut-off level of 900, past which regulatory action would be required.

P 39: The report states "since SO2 emissions have not been measured from the recovery boiler exhausts and SO2 emission testing is not normally required for B.C. kraft pulp mills, data from another Canadian pulp mill have been used to estimate these SO2 emissions." It further states "this high efficiency SO2 removal within the lime kiln has been demonstrated on other mills to be over 90% efficient and therefore the existing mill is not considered to be a major emission source for SO2." Both these assumptions are entirely non-scientific, as 90% is not particularly efficient and equipment works differently in different plants.

SO2 emissions will increase from a current level of 26 tons/year to 959 tons/year (p. 47), an increase of 36.88 times the original level. Due to a lack of air dispersion information, there is no way to evaluate the effects of this on air in the U.S.

TOTAL REDUCED SULPHUR

"Model results of the overall area indicate that the level B concentration may be exceeded (on TRS), with the highest predicted ambient TRS levels occurring on the hillside just to the south of the mill." (p.97). For the overall study area, TRS over a 1-hour averaging period will be 49 ug/m3, while the Level A maximum is 7 and the Level B maximum is 28 ug/m3 (p.90). The 24-hour averaging period is also exceeded for Level B. However, although Level B will be exceeded, the report (p.97) states that "with the reduction in TRS emissions by nearly 85% following the mill expansion, the ambient air quality levels and the expected frequency of adverse odor levels should be significantly reduced." The report should state the current air concentration of TRS.

NITROGEN OXIDES (NOx)

Oxides of nitrogen will increase from 463 tons/year to 922 tons/year (p.47). The predicted ambient air quality NOx levels for the overall area is 273 ug/m3 for the 1-hour averaging period, with

400 ug/m3 being the Level A maximum. However, this does not include an assumed background of 40 ug/m3 (which would raise the ambient level to 313 ug/m3) or supplemental fuel which may be used. The report admits (p.42) that "the oxides of nitrogen emissions (NOx) will increase from the recovery boiler and lime kiln as a consequence of the increased capacity of the mill." However, the report continues, "NOx emissions of this magnitude are not predicted to be a significant concern in rural areas such as Castlegar."

However, nitrogen oxides are converted to NO2 by the ozone (O3) in the atmosphere. The document asserts that assuming all the NOx will be converted to NO2 is an erroneous assumption. However, if it was to occur, "then the measured levels of ambient NO2 would be consistently exceed the 1-hour Federal or Provisional Maximum Acceptable level and would sometimes exceed the Maximum Tolerable Level. This level required abatement without delay to avoid further deterioration of conditions to an air quality that endangers the prevailing lifestyle or, ultimately, to an air quality that poses a substantial risk to public health (p.95)." The report goes on to state that "in reality, the NO component, or the major part of the combustion NOx emission, is only gradually converted to NO2." It is up to the reader to imagine how this time delay will solve the problem. This should be spelled out clearly in the text.

CONCLUSION OF AIR QUALITY

Although the summary statements in the report state a large improvement in air quality, the text of the report does not substantiate this. A chart or table, showing the current ambient air quality (in ug/m3) and the projected air quality, compared to Levels A and B, should be provided.

SOLID WASTE

P. 172: "Current solid waste generation from the pulp mill includes lime mud, slaker grits, bark, scrap lumber, waste pulp, dredged wood, and scrap metal." On p. 177 it cites Table 7-3 as containing a complete breakdown of the waste sources and types; however, this table was not found. No specific volumes for the waste generated is given at all.

Soils in the area of the existing/expanded landfill are fine sands, sand and gravel and relatively thin layers of silty sand. These are highly permeable. The landfill site is approximately 30 m above the groundwater table, and the groundwater levels rise and fall with the river levels.

P.174: The mill is operating the landfill with a permit which originally allowed for the discharge of 30 cubic meters/day and has since been amended to allow the deposition on average of 70 cubic meters/day.

"To minimize the generation of leachate, surface runoff is diverted around the landfill in ditches... Leachate from the landfill is directed via ditches into effluent either evaporates or infiltrates the soil leaving behind a solid residue. Occasionally the solid residue is cleaned out and landfilled." In other words, the leachate (which is rich in dissolved ions, tannins and lignins) could reach the groundwater either through infiltration when it is in liquid form, or leachate from the landfill where the solid residue is buried. Groundwater quality should be monitored up and down hydraulic gradient from the landfill.

The report states "Given the small volume of leachate generated" (no volume figures are ever given" "and the likelihood that the leachate percolates into the underlying sand and gravel" (and ultimately GW), "it is unlikely that any leachate constituents would be present in sufficient quantities or concentrations to be of predictable concern." This is very unscientific, and could therefore cause "unpredictable concern." The report then quotes an MOE report which concluded that the solid waste disposal plan did not create negative impacts on the receiving water or groundwater, but this report was from 1977. A leachate analysis is presented on p. 175, but this is from 1976. In this leachate analysis, the sample was improperly taken, therefore the lab would not guarantee the results.

Why the analysis was not re-done in a standard bottle is not given. In any case, groundwater should be monitored up and down gradient from the landfill utilizing monitor wells.

P.177: "Using solvents and oils will be.... disposed of in an appropriate manner offsite," which leaves questions in the mind of the reader.

P 178: "The mill will continue to collect ship pile and hog fuel leachate and direct it in a manner to filter through the soil to groundwater, and avoid any direct release to surface waters." Again, the groundwater quality should be monitored.

CONCLUSION AND RECOMMENDATIONS SECTION

P 179: The statement that toxics are insufficient to cause sublethal effects on aquatic organisms can only be support by further bioaccumalation studies. The statement "at Birchbank, the Columbia River has assimilated most of the pulp mill effluent" is highly misleading as discovered previously. Thousand of tons of waste has been and will be washed down the Columbia River. Dioxins and furans have been found in Lake Roosevelt fish (press release 2/2/90, Washington Dept. of Ecology, Spokane office).

DATA GAPS

PP 179,180: We agree with those data gaps listed. The following should be added: Information concerning the volumes and types of materials, particularly AOx and wood fibers, and their ultimate fate in the Columbia River should be developed. Sediment sampling of the river should take place from the Celgar discharge to Grand Coulee Dam to determine the degree of accumulation and fate of the waste products.

P. 181: A contingency plan should be developed if questions 1 or 2 are answered in the affirmative.

P 184: Downstream sediment analysis should be added per above (p180) comment.

The concept of dilution being the solution to pollution is not acceptable especially when compounds such as organochlorines are involved. Pre-expansion monitoring needs to take place. The effects of this mill are not restricted to just the local area but seen many miles downstream in both sediment and tissue samples.

Pre-expansion monitoring should include zooplankton, benthic feeders (suckers, dace, chub) and predatory feeders (whitefish, rainbow, walleye and sturgeon). Monitoring should also include sediment samples. The organism samples should have a compliment of various age class from all organisms and at various locations above and below the mill. The long lived species of predatory fish may show greater accumulation of the organochlorine compounds.

Post-expansion monitoring should include the same components as pre-expansion monitoring.

Flow data and sport fishing data should be more up to date than what is given in this report to adequately evaluate the potential effects of the mill expansion.

Continuous waste discharge monitoring equipment should be mandated wherever the technology exists. These should be checked daily and violations immediately reported.

LACK OF ALTERNATIVES

The Celgar EIA did not examine alternative pulp mill technologies, such as hydrogen peroxide. I understand (according to EPA) that B.C. Environment has been examining this issue. The EIA should provide a section on the status, feasibility, and efficiency of alternative technologies.

NEED FOR FURTHER REVIEW

Based on the aforementioned comments, we urge the B.C. Ministry of Environment to require Stage II Analysis of this project.

FOR THE FUTURE

We encourage the development of joint cooperative monitoring projects between Canadian and U.S. entities. A policy to reach zero discharge of all persistent toxics should be a joint Canadian-U.S. goal.

It has become evident that we (U.S. interests) have been far too long lax in the area of comprehensive monitoring of the "upper" Columbia River and Lake Roosevelt. It is vital that more rigorous and extensive monitoring begin as soon as possible to ascertain the effects of past discharges and predict the effects of future discharges on water quality, the aquatic environment, and human health. The members of the Lake Roosevelt Water Quality Committee stand ready to work with anyone in Canada and the United States to see that this is done.

Thank you for opportunity to comment. Please keep us informed of progress on the Celgar issue. We would appreciate receiving copies of any updated or new information and analysis on this and other Columbia River projects.

Very Truly yours,

Gary W. Passmore

Gary W. Passmore
Director of Environmental Trust
CCT*

cc: file

*Chairman, Lake Roosevelt Water Quality Committee

Environment Canada
Environnement Canada

Atmospheric Environment Service
Service de l'environnement atmosphérique

700-1200 West 73rd Avenue
Vancouver, B.C. V6P 6H9

7572-2

7572-2

8725-89(PAESS/BT)

February 20, 1990

Dr. L.M. Churchland
Water Quality Branch
Inland Waters
Pacific & Yukon Region
502 - 1001 West Pender Street
Vancouver, B.C.
V6E 2M9

Dear Dr. Churchland:

Re: Environmental Impact Assessment - Celgar Expansion

In response to your letter of January 9, 1990, the above noted EIA has been reviewed by Atmospheric Environment Service, Pacific Region.

Our comments and concerns resulting from the review are attached for your consideration. If you have questions or require clarification, please feel free to contact me at (666-2184).

Yours truly,

R.B. Thomson

R.B. Thomson

cc: R. Horne
Atmospheric Environment Service
Ottawa

attachment

Canada

February 19, 1990

Review of the Celgar Expansion EIA
Atmospheric Environment Service, Pacific Region

General Comments:

The review by Atmospheric Environment Service, Pacific Region concentrated on the meteorology, climatology and air quality of or related to the project. Sections in the EIA that dealt with these aspects covered a great amount of detail and discussed a number of environmental concerns. A few environmental concerns remain unanswered: the total loading of sulphur and nitrogen compounds to the environment, the effect of the Effluent Treatment System on Total Reduced Sulphur (TRS) levels in the valley and the complete inventory of emissions expected from the plant.

Specific Comments:

1. The graph on page xii of the Executive Summary indicates that SO_2 will increase from 26 kilotonnes/year (kt/yr) to 959 kt/yr and NO_x will increase from 463 kt/yr to 922 kt/yr. It is documented in the EIA that the air concentrations resulting from these large increases in emissions will be within Provincial and Federal ambient air quality objectives, however the increased loading to the environment as wet and dry acidic deposition has not been documented. If one simply considers a linear relationship, the loading of sulphur will increase by more than 35 times and nitrogen by a factor of two. There are no recognized guidelines in western Canada for levels of wet and dry acidic deposition to the environment, however this is an important environmental concern and a local public issue. The only way of identifying an environmental impact is to express the loading to the environment as a deposition.

2. It is stated (section 3.2.5 page 42) that the excess NO_x is not predicted to be of a significant concern in rural areas such as Castlegar. If the formation of ozone is one of the significant concerns not expected to develop, consideration should be given to local VOC/NO_x ratios. Natural VOC's can be important when NO_x is available in appropriate concentrations. When increases in NO_x are anticipated it should not be taken for granted that atmospheric chemistry will not produce further pollutants of concern. This issue may have to be addressed with a photochemical model.

3. The addition of the Effluent Treatment System adds a significant source of TRS (2.778 grams/second). It is not clear that the air quality modelling strategies have adequately accounted for this ground-level source. Of particular concern is the effect that this source will have under limited atmospheric dispersion conditions An inversion situation where cold or cool air is trapped in the valley may allow drainage winds move the pollution toward sensitive receptors. This is also another source of sulphur to be considered in the question of total loading to the environment.

4. In several instantances, waste material (sludge) is being burned in boilers etc. The impact of this procedure on the emissions inventory has not been documented in the EIA.

5. The increase in the amount of water vapour emitted will also have an impact on the local environment. During cold weather, the fog produced by the mill and the Effluent Treatment System may very well cause poor visibilities in the valley. The formation of rime ice on roads and equipment should be considered.

1

MAR 6 REC'D

75-72-2

Environment Canada MEMORANDUM Conservation & Protection

To - L.M. Churchland
Chief, Water Quality Branch
P&Y Region, Vancouver

our file D:dioxin/celgar.mem

From - John Elliott
Canadian Wildlife Service
P & Y Region, Delta

date - Mar. 5/90

Subject - Comments on EIA for proposed Celgar bleached kraft mill expansion

A package on the above matter was passed to me by L. Retfalvi for comment. CWS would like to submit the following:

CWS concerns focus on Sections 6.2 and 6.4 on the issue of chlorinated dioxin and furan emission to the aquatic environment and also on Sec. 8.0 regarding recommendations for monitoring.

6.2 Existing Mill - Chlorinated dioxins and furans

The levels of 2378-TCDD and 2378-TCDF in fish collected downstream of the existing mill are high enough to be of concern, both from the perspective of wildlife consumers of those fish and of wildlife feeding on the same food chains as the fish species collected by Mah et al. in Table 6.5.

Although, more research is required, we can assume at this point that levels in forage fish greater than 5 ng/kg will have biological effects on at least some species of birds. This is based on the following data:

1) The bioconcentration factor from fish to birds for 2378-TCDD is in the order of 20 to 25 (Elliott et al., 1989 Environ. Pollut., 59, 91-114).

2) Great Blue Heron embryos collected in 1988 from a colony near the kraft mill at Crofton had mean levels of 160 ng/kg. They displayed a variety of sublethal effects, such as reduced body weight, subcutaneous edema and induction of hepatic enzymes, which can be attributable to PCDD and PCDF exposure (Bellward et al,. in press, J. Toxicol. Environ. Health).

3) Great Blue Herons do not appear to be a particularly sensitive species to the effects of TCDD-like compounds. Other wild birds may be at greater risk. Therefore, 5 ng/kg is not a conservative criteria for predicting effects on wildlife.

Consideration of possible effects of PCDDs and PCDFs from the mill should not be restricted to water birds, which because of the climate in the region, will mostly migrate south in winter and therefore, not be exposed to year-round contamination. Potential impacts of persistent contaminants from the mill should also consider resident aquatic furbearing mammals, such as mink and river otter.

CWS submitted a risk assessment of expected impact of effluent from the proposed ALPAC pulp mill in Alberta. We determined that TCDD levels at the limit of detection (10 ppq) in treated effluent would still result in levels of 4.5 ppt in fish in the diluted effluent. This prediction was supported by more complex modeling by D. Muir of DFO in Winnipeg. Levels of 4.5 ppt in fish could have potential effects on sensitive species such as mink. Details of this assessment can be supplied on request.

Mink and river otter are of particular concern on the Columbia because of the cumulative impact on downstream populations in the U.S. Henny _et al_. (1981, Proc. Furbearer Conf., 1763-80) found elevated levels of PCBs in mink from the lower Columbia River. There were also indications of reduced mink harvest in that area. PCDDs and PCDFs were not analyzed in those mink; however, they may be contributing to the total toxic burden and be impacting the population.

6.4 The Expanded Mill - Chlorinated dioxins and furans

Expansion of the mill must result in a substantial net decrease in PCDD/PCDF input to the aquatic environment. We recognize that the recovery time of the system as a result of past PCDD/PCDF input is unknown; therefore, it may be sometime before levels in aquatic biota decrease, even given reduced input from the expanded mill.

8.0 Conclusions and Recommendations

Regarding aquatic monitoring, collection and analysis of forage fish for chlorinated organics, provided a variety of species are selected and the monitoring is continued and done properly, should serve to protect wildlife consumers. This assumes that the finding of elevated levels of contaminants in aquatic biota will be acted upon in terms of enforcing reductions in effluent concentrations.

We would also recommend that where there is suitable downstream habitat for mink and/or breeding waterfowl that the company be required to:

1. Conduct a field census of the mink, otter and waterfowl populations for a prescribed distance upstream, downstream and at a third site on a comparable but unimpacted stream.

2. Collect samples for residue analysis; this could be done using resident trappers in the case of mink.

3. Repeat the survey at intervals of two years for a minimum of 10 years.

4. Alternatively fish caught downstream could be fed to captive mink to determine the effect on prescribed toxicological endpoints, especially reproduction.

TELECOPIER MESSAGE

TO: Leslie Churchland, Chief, WQB, IW.

FROM: John Elliott, CWS, Delta

SUBJECT: Algar EIA

DATE: 6.3.90

PAGES TO FOLLOW: 3

IF NOT WELL RECEIVED PLEASE CALL CANADIAN WILDLIFE SERVICE DELTA, B.C. AT (604)946-8546. THANK YOU.

February 26, 1990

Memo to: Fred Mah
Inland Waters and Lands

FEB 26 REC'D

From: L.N. Adamache, P.Eng.
Manager, Forest Products Program

Re: Power Consolidated, Castlegar Pulp Mill

November 21, 1990, I provided you with a statement of requirements for the proposed pulp mill expansion based on the existing Pulp and Paper Effluent Regulations.

I have reviewed the document entitled Celgar Pulp Company, Bleached Kraft Mill Expansion, December 1989 provided to our office by L.M. Churchland which outlines the class of technology proposed by the Company for treatment of the wastewater. Assuming good design and operation of the proposed wastewater treatment facilities, the resulting effluent quality will comply with the current Regulations outlined in my previous memo.

In my November 21st memo, I also advised that if it is shown the regulations are not adequate to protect fish, site specific regulations may be required. In addition, regulations are currently being considered under CEPA for dioxins, furans and other chlorinated organics. I cannot provide you with an assessment of treatment technology based on future requirements because these requirements are unknown.

L.N. Adamache

c.c. M. Ito
B. Kelso

I N T E R O F F I C E   M E M O R A N D U M

Date: 26-Feb-1990 02:50 P
From: Larry Adamache
ADAMACHEL AT A1 AT
Dept: EP/Forest Prod., Pa
Tel No: (604) 666-3568

TO: Marguerite Henderson (HENDERSONM AT A1 AT IWLVAN

Subject: Memo/feb26/90

A Document is attached to this message

MAR 5 REC'D

Government of Canada Gouvernement du Canada

MEMORANDUM NOTE DE SERVICE

TO / DE / A
Fred Mah
Inland Waters, P. & Y. Region
Conservation & Protection
1001 West Pender, Vancouver, B.C.
V6E 2M9

FROM
Bryan Kelso, Manager
Freshwater Assessment Projects
Environmental Protection
Kapilano 100, Park Royal
West Vancouver, B.C.
V7T 1A2

Security Class-de Séc.

Our File-N/Référence 4804-37/W175-1

Your File-V/Référence 7572-2

Date March 1, 1990

Subject / Objet CELGAR Pulp Company Prospectus, December 1989

We have reviewed the document titled "Bleached Kraft Mill Expansion, Environmental Impact Assessment - December 1989" with respect to environmental matters under the Federal jurisdiction of the Fisheries Act. The Report more than adequately fulfils the requirements of a Prospectus document.

The new technology proposed for the mill will be a definite improvement over the existing process of the present mill. However, because this is an expansion of the mill production from 560 to 1200 aid dried tonnes of bleached kraft pulp, we do have some concerns as to what potential impacts this project development will have on the fisheries resources and the water quality of the Columbia River. While the prospectus does contain some impact assessments reviews there are still some outstanding concerns and in this regards the Project should proceed to Stage I as per the Major Project Review Guideline process.

In order to evaluate this project further the following additional comments must be included in the Stage I:

A Mill Process Design

- see memos L. Adamache to Fred Mah dated Feb. 26, and March 1, 1990.

B Biophysical Inventory and Impact Assessment

a) Fisheries

The prospectus refers to fisheries resource studies conducted in the early 1980's, but contains no new updated resource information. (e.g. on page 108 it refers to studies conducted by R.L. & L. Consultants but then they state that "...the sampling methods used may have underestimated the abundance of larger, open-water species (e.g.

rainbow trout)". Also they comment on walleye and sturgeon stocks but but do not substantiate this with data. In order to properly assess any impact the development may have on fisheries resources it is imperative that a current resource assessment be made. This should include feeding habits, migration, spawning and rearing patterns.

b) Hydrology

- Surface water flow characteristics have been properly addressed in the Prospectus, However, detailed hydraulic studies should be done on the effluent mixing pattern in the river. Also, a scenario should also be developed on the effluent flow if the B.C. Hydo proposed Murphy Dam project was to proceed.

- Groundwater/surface water relationships for both the landfill site and the biotreatment ponds should be conducted to insure there will be no leaching from these facilities directly into the Columbia River.

c) Freshwater Biology

- Water Quality/Sediments/Biota.. As stated in the Conclusions of the Prospectus, the "Water quality measurements in the Columbia River have not been adequate to accurately describe current water quality in the vicinity of the mill and the downstream receiving environment." In particular more information is required on chlorinated organics, especially in sediments and biota for dioxins, furans, chloroform, chlorophenals (2,3,6-tri; 2,3,4,5-tetra; 2,3,4,6-tetra; 2,3,5,6-tetra; penta), chloroguaiacols (3,4,5-tri; tetra), chlorocatecols (3,4,5-tri; tetra) and AOX in water. Resin acids, total phenols, tannins/lignins and dissolved sodium should also be better defined. This should be done at several stations such as upstream from the mill but below the dam, at the limit of the present IDZ, downstream where complete mixing occurs but upstream of Kootenay River confluence, and one to two sites further downstream, including a site at the border as defined by IW.

d) Impact Assessment

- Receiving water objectives- The Prospectus refers to the document "Pollution Control Objectives for the Forest Industry" and the numbers and definitions within that document pertaining to receiving waters. The Province of B.C. has since been developing site specific water quality objectives and for those areas were they have not been developed they have developed a working criteria for water quality (Approved and Working Criteria for Water Quality, MOE, Water Management Branch, March, 1989.) Also they have prepared a document "Principles for Preparing Water Quality Objectives in British Columbia, WMB, Sept. 1986". In this document they state that the objectives do not apply within the initial dilution zone and that the extent of the initial dilution zone is defined on a site specific

.../3

basis, with due regards to the water uses, aquatic life and otherwaste discharges. In the case of the Columbia River and the Celgar discharge, the IDZ has to be evaluated on this bases and not the criteria of the 1977 Pollution Control Objectives for The Forest Industry. Further, the Prospectus refers to data that at present does not meet all objectives outside of the IDZ. An assessment of the new mill discharge must be made to insure water quality objectives are met at all times under all flow regimes.

- fish tainting.. The Prospectus states that "Fish tainting compounds ... are predicted to be virtually non-existent in the treated effluent so fish tainting is not predicted to occur." The exact cause of fish tainting from pulpmill effluents are not known and in this regards tainting of fish flesh could still occur downstream of the pulp mill discharge.

- organochlorine compounds.. as stated on page 169, further general studies are required on the fate of these organochlorine compounds. While the actual fate and pathways of these compounds in the receiving environment are not known and the results of the research presently being conducted will not be known in time for this project it is imperative that at least the present levels in the water, sediment, and biota be documented in the Stage 1 so that future monitoring results will determine if the mitigative measurements being proposed by Celgar in their expansion are sufficient to reduce these compounds in the receiving environment. Also there must be some discussion in the Stage 1 with regards to the question posed on page 181 as to whether the expanded mill effluent will exert sublethal or chronic effects on aquatic organisms in the receiving waters of the Columbia River.

-nutrients.. comments to be provided by IW.

Bryan Kelso

cc: L. Adamache

INTEROFFICE MEMORANDUM

Date: 02-Mar-1990 03:17 PST
From: Bryan Kelso
KELSOB AT A1 AT EPVAN
Dept: EP/FWG Manager, Pacific
Tel No: (604) 666-5193

TO: Marguerite Henderson (HENDERSONM AT A1 AT IVLVAN)

Subject: Celgar

A document for Fred Mah and Leslie Churchland is attached to this message.

Bryan

MEMO

March 5, 1990

To: Don Bernard,
Water Impact Assessment Div.,
Water Planning & Management Br.,
Environment Canada.

From: Hugh Liebscher, Hydrogeologist,
Water Planning & Management Br.,
4 - 1001 West Pender St.,
Vancouver B.C. V6E 2M9.

Subject: Environmental Impact Assessment - Celgar Pulp Mill Expansion

I have reviewed both December 1989 documents titled "Modernization and Expansion" and "Environmental Impact Assessment" for the above site and submit the following comments.

General Statements:

1. Both documents appear to be limited to the prospectus stage and fall far short of providing (P. iv.) "A comprehensive analysis of the environmental impacts associated with the expansion" or "an environmental impact assessment".

2. This review will fall short of your expectations in that I am not familiar with the:
   a. internal operations and associated environmental problems at bleach kraft pulp mills.
   b. constituents, volumes and toxicities of the weak black liquors, concentrated black liquors, green liquors, white liquors, acid sewer, alkaline sewer and general sewer discharges and landfill wastes.

3. With regards to ground water, there is very little description of site hydrogeology. What little ground water contamination work has been done appears to be based on an optimistic interpretation of very little data.

4. With regards to contaminants likely to be identified in the local ground waters, the consultants have done an interesting job of assuring the reader that effluent discharges have improved due to improved chemical manufacturing processes and will continue to improve as development progresses. They have fallen short of identifying (in non pulp mill jargon) specifically how

this has been accomplished, how effective each of the processes are and specifics of what will be accomplished in the future.

5. The proponents feel that ground water monitoring at the landfill (and presumably else where) is not necessary because (P. 185 EIA) "...the low, intermittent nature of leachate generation indicates this is not a significant discharge source." It appears that there has been no attempt to monitor ground water contamination at the landfill or else where on site. In view of the types of wastes and volumes of wastes disposed at the landfill it would likely be a good idea to monitor both the landfill wastes, leachates and local ground waters.

6. Ground water remediation from previous site activities may be required to minimize potential downstream health and environmental impacts.

Specific Ground Water Concerns:

1. Landfill and mill site are located on sands and gravels which are continuous with the river. Leachates generated and discharged from the landfill will flow downwards to the water table where they will contaminate local ground waters. The contaminants will then flow down valley and presumably flow into the river. Because of the shallow hydraulic gradient towards the river there may be a downstream flow component remaining in the alluvium. Similarly, liquids stored and handled in the manufacturing process which are spilled, leaked or washed into the sands and gravels are expected to behave in a similar manner with little attenuation.

2. Discussions of surficial geology at the landfill and the leachate exfiltration pond indicates that there is known ground water contamination at the landfill. There have been no attempts to define the chemistry of the leachate, quantify volumes of leachates or impacts on ground waters.

3. Landfill wastes consist of materials listed on P. 177. They include a number of waste materials from operations including used oil and solvents.

4. The long term operation of the mill at or exceeding capacity has resulted in "...decreasing efficiency of operation of chemical recovery and waste control". How much additional wastes were generated and shipped to the landfill? Will this be prevented in the future?

③

5. The proponents intentionally discharge leachates to local ground waters. P. 178 "The mill will continue to collect chip pile and hog fuel leachate and direct it in a manner to filter through the soil to groundwater, and avoid any direct releases to surface waters." What attenuation of leachates occurs in the sand and gravels? What are the impacts on ground water quality? What volumes are discharged to the landfill daily? What is the daily chemical loading into the river via ground water flow? Will continual discharge lower subsurface permeabilities?

6. Environmental monitoring program is inadequate in that it does not include ground water assessment, monitoring at the landfill or else where.

7. Consideration has not been given to pipeline leakages or rupture and potential consequences on ground water.

8. The proponents have not identified locations of nearest downstream surface water users or nearest downstream groundwater users nor have they identified existing and potential impacts on their water supplies.

9. Monitoring must include ground water.

10. The PCB contaminated transformers will be stored in a clearly marked, secured area. Will this include overhead shelter and impermeable bermed flooring?

11. It is not clear how AOX compounds will be reduced.

12. Will the proposed higher discharge temperature have a measurable impact on Columbia River flora and fauna?

13. What leachates are expected to discharge from the landfilled dregs from the green liquor clarifier and grits from the lime slaker?

14. What are the designs of the spill control basin, low rate activated sludge lagoon, biotreatment retention pond and cooling effluent lagoon? Is there risk of ground water contamination from these structures?

15. Table 5.18 identifies effluent characteristics based on future production rates. Approximately 1,800 Kg of AOX compounds will be discharged to the river daily. How much chlorinated organics will go to the landfill? How much will be burned and how much will discharge to the river via contaminant ground water flow?

16. What type of granular cover is used on the landfill?

17. The proponents indicate that landfill leachate generation is "low". What data exists and what is meant by the statement?

18. The proponents interpretations of landfill leachate generation and impact appear to be based on very little data. What data was used to arrive at these conclusions?

19. What kinds of solvents are dumped at the landfill? What kinds of solvents and oils are occasionally dumped at the landfill? Are no environmental or health impacts expected for downstream users?

20. An experienced consulting hydrogeologist should carry out a detailed ground water investigation of the landfill and mill properties. The report should address local ground water flow directions, flow rates, contaminant flow directions, contaminant flow rates, land filling practices, health risks, environmental risks and remedial options (if required).

I am enclosing both reports with comments on the margins which you are welcome to use.

If you or others would like clarification of the above please feel free to give me a call at 665-0807.

c.c. L.M. Churchland
F. Mah
~~L. Pharo~~
B. Kelso

Government of Canada
Gouvernement du Canada

MEMORANDUM NOTE DE SERVICE

TO / A
L.M. Churchland
Chief, Water Quality Branch
Inland Waters, P. & Y. Region
Conservation and Protection

FROM / DE
Toxic Chemicals Coordinator
Water Quality Branch
Inland Waters
Conservation & Protection, P&Y Region

Security Class_de Séc.	
Our File-N/Référence	7572-2
Your File-V/Référence	
Date	March 7, 1990

Subject / Objet **Water Quality Branch Comments on the Environmental Impact Assessment (E.I.A.) for the Celgar Pulp Mill Expansion**

There is little doubt that the proposal to replace the existing process with new pulping and bleaching technology together with biological treatment will reduce discharges of most of the environmental contaminants. However, after reviewing the E.I.A.. we have identified several major data gaps which should be addressed in a Stage I submission.

They are as follows:

(1) We find that there is little discussion on the environmental impact of discharges/emissions from the expanded mill. Discussions on environmental impact should be more detailed especially with regard to discharges such as nitrogen and total suspended solids (TSS) which will increase from the existing operation. Please note that there are data available on nitrogen and phosphorus in the Columbia River through the Canada/B.C. Water Quality Monitoring Agreement.

(2) As discussed in our letter of January 30, 1990 to Mr. R. Crozier of B.C. MOE, the existing aquatic environmental conditions in the Columbia River downstream of the pulp mill and at the border, with respect to the toxic organic compounds, is not known. This information should be submitted with the Stage I submission.

(3) The statements in the E.I.A., such as the predicted reduction of absorbable organic halides (AOX) to 1.5 kg/ADt of pulp, should be substantiated. In the absence of pilot study results, operating data from an existing mill or mills using similar technology under similar climatic conditions and using similar wood species as the proponent is recommended. In areas where new technology is proposed, primary references should be supplied.

(4) In view of the short retention time (3 days including cooling) in the biotreatment ponds, operating efficiency data from an existing treatment similar to that of the proposed system with the same climatic conditions should be supplied. A more detailed description of the treatment system is required e.g. are the ponds lined with plastic or clay?

(5) In view of the fact that TSS will increase by 81% an indepth discussion with respect to the impact is necessary.

(6) Given the fact that most of the hydrophobic toxic organic compounds will be associated with the biosolids, the feasibility of utilizing clarification or ultrafiltration techniques for the final effluent should be discussed.

(7) The impact of 1,200% increase of nitrogen to the Columbia River system should be assessed. Due to the large input of phosphorus from Cominco at Trail, the Columbia River at Waneta is probably nitrogen limited. What effect would this increase have on the Columbia River at the border?

(8) The expanded mill will increase SO_2 and NO_2 emissions from 26Kt/yr to 959 kt/yr and 463 kt/yr to 922 kt/yr, respectively. The potential acid precipitation is of concern. The feasibility of using a scrubbing system to reduce these emissions should be discussed.

(9) Assessment on the impact of filling in some of the foreshore areas adjacent to the mill should be provided.

(10) The hydraulics of the Columbia River from the Hugh Keenleyside Dam to the confluence of the Kootenay River, especially the formation and breakdown of the hydraulic dam, should be understood and the distance required for complete mixing under various flow conditions provided.

Specifically, our comments are as follows:

Page xiii, Para. 1. states -

"...... the latest state of the art processes and equipment to reduce the mill impact on the environment." This section should include a discussion of the feasibility of installing scrubber for SO_2 removal and ultrafiltration for the final effluent for removal of biosolids.

Page 16.

The PCB Disposal Plan developed in conjunction with MOE should be supplied in the appendix.

Page 19, Table 3.1.

Effluent characteristics for the proposed expansion should be based on pilot study results. In the absence of such, effluent characteristics should be substantiated with operating data from an existing mill or mills of similar design, located in the same climatic zone and utilizing similar wood species.

Page 21, Table 3.2, Column 2.

Column heading: Existing (Jan. - July, 89). The figures in this column multiplied by the production of 545 ADMt/d do not agree with the figures on page 19, Table 3.1. Columns 3 and 4, Untreated Proposed Mill, and Treated Proposed Mill respectively, should be substantiated.

Footnote 2. "AOX value is the 1996..." should read "... 1994 ...".

Footnote 5. It is unclear whether the volume described on page 19 included the cooling water or not. Has the temperature under column 3 taken this into account?

Page 24, Para. 2.

The statement "..... the effluent flow is dropping 96,000 m^3 to 73,600 m^3 per day (... including 39,000 m^3 of cooling water)" Figures in Table 3.1 and 3.2 on pages 19 and 21, respectively, do not reflect this.

Page 24, Para. 5.

A reference should be supplied for the statement that approximately 40% of the lignin will be removed by oxygen delignification.

Page 25, Para. 1.

The statement "..... dioxins and furans will be reduced to below current limits of detection" should be substantiated.

Page 26, Table 3.3.

Again the importance of citing operational data from a mill of similar design is emphasized. On page 24 it is stated that the BOD is reduced by 40% by oxygen delignification while Table 3.3 states 20-40% is removed.

Page 29, Para 4.

Cooling water volumes do not agree with footnote 5 on page 21.

Page 31.

What is the efficiency of operating biological treatment systems with a 3 day retention time including cooling? What is the operating efficiency of treatment systems with a similar design? Air spray cooling will increase total reduced sulphur (TRS) in the atmosphere. Have cooling towers been considered as a alternative? It would reduce TRS and fog formation. We understand that space is at a premium with Celgar. Assuming that a cooling tower will take up much less space than a cooling pond, the installation of such equipment may leave enough space for biological treatment ponds with a true 3 day retention time.

Page 34, Para 1.

The statement ".... the retention time can be reduced to two days or less ....." should be supported by data from existing operations.

Page 42, Para 5.

The statement "However, NO_x emissions of this magnitude are not predicted to be of significant concern ..." should be substantiated.

Page 46, Para 5.

The statement indicating only 1 to 10% of the AOX entering the lagoon is present in the effluent clarifier sludge should be substantiated with data from a similar operating treatment system.

Page 47, Table 3.9.

Emission figures for the expanded mill should be substantiated with data from an operating mill of similar design. Is the TRS and moisture from the treatment ponds included? High SO_2 and NO_x emission is of concern.

Page 54, Para 1.

What is the deposition rate of SO_2 as well as NO_x (both wet and dry)?

Page 54, Para 3.

The reference (Tradewell, 1989) is not listed in the Reference section.

Page 102, Para 4.

The average velocities mentioned in the last sentence should be substantiated.

Page 108, Para 2.

There is no reference for the statement that Hugh Keenleyside Dam has resulted in dissolved gas supersaturation. It should be noted that there is a lock system for boats to move pass Keenleyside Dam. Therefore fish can still move pass the dam when the locks are open.

Page 108, Para 3.

The use of the foreshore for log storage should be described in detail and its impacts should be assessed.

- Fisheries resources to the U.S.-Canada border should be discussed.

Page 110, Para 3.

Are there any reasons for the decline of Kokanee escapement in Norns Creek? The rearing areas for young of the year should be determined.

Page 114, Para 4.

The distance required for complete mixing should be determined by dye studies at low flow.

Page 114, Para 5.

The reference Dvernychuk, 1989 is shown as 1988 in the References Section. Should existing effluent flow rate read 1.134 m^3/s instead of 1,134 m^3/s?

Page 117, Para 1.

The time required to break down the hydraulic dam and the effluent mixing pattern under these conditions should be determined.

Page 117, Para 3.

Grab sample results are sometimes very misleading. Composite effluent samples when production is at its peak may be more useful.

Page 120, Table 5.9.

Should the heading "Predicted River Water Quality at Low Quality...." read:

Predicted River Water Quality Change at Low Flow?

Footnote 1 reference Dvernyechuk (1989) is not in the Reference Section.

Page 129, Para 2.

The reference (Pease, 1974) is not shown in the Reference Section. Are there any data collected around the log storage areas?

Page 129, Para 3.

Are there any data to prove that the leachates do not reach the river directly or indirectly through groundwater?

Page 129, Para 4.

Total organic carbon (TOC) concentrations shown on page 124, Table 5.11 are 8.1 and 9.1 for below Keenleyside and Birchbank, respectively, for July 26, 2.6 and 3.8 for September 3, and 12 and 13 on February 10. One cannot imply that the relatively high TOC values found on July 26 are due to hypolimnetic withdrawal/turnover events unless the flow condition is known.

Page 130, Para 4.

What is the sediment oxygen demand in this area? If no information is available, data should be obtained so that the impact of foreshore log storage can be assessed.

Page 132, Para 1.

It should be noted that Table 5.9 showed that the total P change on complete mixing is +0.004 mg/L instead of +0.003 mg/L.

Page 132, Para 2.

It should be noted that Table 5.9 showed an effluent temperature of 28°C. instead of 27.4°C.

Page 134, Para 2.

This paragraph mentioned concentrations of volatiles such as sulphides and mercaptans. What is the reference for these figures?

Page 134, Para 3.

As the toxicity and half life of individual resin acids are different, a discussion on the concentration of individual resin acids, especially the more toxic forms, is more meaningful. The total resin acids shown on page 135 should read 2.263 instead of 2.197.

Page 134, Para 5.

This paragraph pointed out the variability of the effluent, whereas the following discussion is based on a single grab sample.

Page 135, Table 5.14.

Columns 3 and 4 should read: 2.263 and 0.035 for total resin acids.

Page 140.

This page is confusing and requires more editing. Is Sphaerotilus a fungus or bacterium (see paragraphs 3 and 4)?

Page 140, Para 4.

Maxwell's conclusions contradict the discussion on page 129, paragraph 4, with respect to total organic carbon.

Page 140, Para 5.

There is no mention of Oscillatoria and Ulothrix in Table 5.17. From what data set is the conclusion made by the last sentence?

Page 141, Table 5.17.

Editing is required with respect to spelling etc.

Page 144, Para 1.

It should be noted that Table 5.12 does not show average concentrations of 0.002 mg/mL in either total or dissolved P. Phosphorus should always be identified as either total or dissolved.

Page 145, Para 1.

A reference is required for the lack of diverse community of mayflies, stoneflies and caddisflies between the dam and Castlegar.

Page 150.

The discussion on effects on the river water quality is inadequate especially with respect to suspended solids.

Page 153, Table 5.20.

It should be noted that % change for temperature should be +7°C. instead of +5°C.

Page 154, Para 3.

A better description of nutrient loadings, including inputs from the Kootenay River and its impacts on the Columbia River, is required. Will the increase in nitrogen affect transboundary conditions at Waneta? Please note that some data is available through the Canada/B.C. Water Quality Monitoring Agreement.

Page 155, Para 1.

See comments for page 153 with respect to temperature change.

Page 155, Para 3.

Impact of log storage should be assessed.

Page 156, Para 1.

The exact cause of fish tainting from pulp mill effluents is not known. Therefore the statement that "... fish tainting is not predicted to occur" is questionable.

Page 159, Para 2.

It should be noted that the EPA review pointed out that the FDA guidelines of 25 ppt are inappropriate for use to protect groups consuming large quantities of locally caught fish.

Page 168, Para 2.

Our data does not support the statement that upstream results indicate other routes of entry and/or other sources for these contaminants. It should be noted that the sediment samples collected upstream showed non-detectable levels and that fish can swim upstream through the lock system on the Keenleyside Dam.

Page 170.

The statement "Laboratory studies suggest .... will reduce dioxin/furan levels to below current detectable levels" requires that the detection limit be defined.

Page 174, Para 4.

There is no data shown for conductance in Table 7.1.

Page 177, Para 3.

Table 7.3 mentioned in this section is not attached to the document. Landfill leachates as well as leachates from chips and hog fuel should be collected and piped to the waste treatment system.

Page 179, Para 2.

There is not enough information to conclude that it is unlikely that the concentration of toxic components is sufficient to cause sublethal effects on the aquatic organisms and possibly result in fish tainting. References or data should be provided to substantiate this statement.

In addition to the data gaps identified, information with respect to the toxic organic contaminants upstream of the International boundary of the Columbia River should be submitted at Stage I.

Page 180, Para 4.

In view of the fact that a hydraulic dam can develop during low flow, a background station should be established above the Keenleyside Dam.

Page 180, Para 5.

Definition of activities relating to log storage on the river and leachate from the mill site as well as stormwater runoff and associated impacts should be supplied with Stage I.

Page 181, Para 3.

It should be noted that the Americans have detected dioxins/furans in Lake Roosevelt fish (Washington State Dept. of Ecology). The statement that "there is little or no evidence that the existing effects of the mill effluent extend past the confluence" should be revised accordingly. Additionally, concentrations of chlorinated guaiacols have been detected in eulachans in the Fraser River estuary (H. Rogers et. al.). It is suspected that these guaiacols are from mills upstream in Prince George, Quesnel and Kamloops.

Page 181, Para 5.

Whenever clams are used to monitor for organochlorines variables such as age, sex, season of collection as well as lipid content should be determined.

Page 182, Para 1.

It should be noted that dioxins/furans are lipophilic and lipid content in suckers is low compared to lake whitefish. Therefore lake whitefish may be better for monitoring than suckers.

Page 184, Para 3.

Until improvements are made with respect to accuracy, precision and detection limits of the analytical methods, and the relationship between dioxins/furans and AOX is known, it is not recommended that AOX only be used as a monitoring tool. Due to the fact that organic contaminants in fish vary with age as well as lipid content, it is not expected that monitoring data collected for dioxins/furans in fish would have the same statistical precision as the inorganic variables.

Appendix 4.

It should be noted that the two lake whitefish samples collected by Mah et al showed different median age (6 and 4) and different lipid concentrations (8.9% and 10.5%). The report showed the correlation of dioxin/furans with lipid content and age. Therefore these data should not be used to calculate the number of replicates required for the monitoring program.

References:

H. Rogers et al., Organic Contaminant UpTake in Eulachans (Thaleichthys Pacificus) Migrating Through the Fraser River Estuary. Science of the Total Environment. In Press.

Washington State Dept. of Ecology News Release, Feb. 1, 1990.

F. Mah

Fred your copy 9461-1-2

Government of Canada Gouvernement du Canada

MEMORANDUM NOTE DE SERVICE

Jack.

FEB 12

TO / A

Jerry Hersch
Health Protection Branch
Western Region

FROM / DE

Chief
Chemical Evaluation Division

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

YOUR FILE - V/RÉFÉRENCE

DATE

February 5, 1990

SUBJECT / OBJET

Environmental Impact Assessments Involving a Number of Pulp Mills in British Columbia

This will refer to your note of January 25, 1990 and recent requests for comments concerning the above subject.

Due to increasing demands to expend a greater proportion of time and resources on many high priority issues we regret that we are currently unable to send representatives to meetings which are called to discuss pulp mill expansions (e.g. CANFOR PRINCE GEORGE MILL). In addition it seems to us that there is little to contribute in specifically reviewing in detail the many environmental impact statements and assessments that are being put forward.

As mentioned previously (see memo dated December 4, 1989 from Diane Kirkpatrick to Jack Forbes) our main concerns in this area would be focused on the potential impact of any new pulp mill or pulp mill expansion on human food systems in the affected area. These concerns would be the same in each case and could be addressed in the following manner.

1) All components of the effluent, air emissions and solid wastes from the pulp mill should be determined. Emphasis should be placed on those substances associated with this type of industrial operation and of most concern from the standpoint of potential hazard to human health (e.g. organochlorine compounds, polycyclic aromatic hydrocarbons and heavy metals).

2) The levels of each of these substances in the local food chain should be determined. (The local food chain would include fish from the area, crops/edible plants grown in the surrounding area, and domestic animals/wildlife raised or captured for food purposes). The levels observed would reflect the background levels of these substances in the environment, as well as releases to date from the pulp mill and other possible sources in the area.

3) An estimate of the potential impact of any pulp mill construction or expansion on the levels of contaminants released into the environment, and the subsequent impact on foods obtained from the vicinity of the pulp mill should be determined.

These general comments would be applicable to all these similar situations. Certainly, we would be prepared to comment in detail on any specific protocols regarding sampling and analysis of fish or other food commodities if and when such protocols are put forward.

We trust that these comments will be useful to you.

B.L. Huston, Ph.D.

Health and Welfare Canada
Santé et Bien-être social Canada

[illegible] File -
Celgar
- copy to
Fred.

Pacific Region
Public Service Health
Medical Services Branch
515 - 757 West Hastings Street
Vancouver, B.C.
V6C 1A1

FEB 12 REC'D

February 8, 1990

Dr. L. M. Churchland
Chief
Water Quality Branch
Inland Waters
Conservation and Protection
502 - 1001 West Pender Street
Vancouver, B.C.
V6E 2M9

Dear Dr. Churchland:

Re: ENVIRONMENTAL IMPACT ASSESSMENT - CELGAR EXPANSION
BLEACHED KRAFT MILL EXPANSION

The proposed expansion of the bleached kraft mill, Celgar Pulp Company, will not be reviewed by this department as there are no resident Indian Bands in the area which otherwise might be affected.

Yours truly,

Richard Lawrence
Regional Manager
Environmental Health Services

Canada

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

E5030-1

TELEX / FAX COMMUNICATION FORM
FORMULAIRE DE COMMUNICATION POUR FAX / TELEX

FAX no - N° de FAX 666-3325	Telephone no - N° de téléphone	Page 1 of / de 2

MAR 5 REC'D

7572-2

To - A Fred Mah, Inland Waters

From - De Susan Anderson, Self Government

Branch - Direction	Division	Program Code - Code de programme
Director General - Directeur général	Director - Directeur	Return to room no. - Retourner à la pièce

Celgar Expansion - inital comments

1) There are no Canadian Indian reserve immediately adjacent to the Celgar Expansion.

2) There are American Indian interests downstream from Celgar, and I understand that they are involved with the Transboundary part of the review process.

3) A significant number of these Indians are the immediate decendants of the Lakes Group of Canadian Indians, whose territory crossed the Canada/US Boundary.

4) Although the Lakes Band is extinct, the American groups have expressed an interest in the territory previously held by the Lakes Band in British Columbia.

I have attached an excerpt from the Lakes Indian Ethnography which was prepared for the American Lakes Indians. This note covers a specific description of the Lakes tribal territory held in Canada, as seen in 1909, when there were still Lakes Indians resident in B.C.

The source document was prepared for the Lakes group in Washinton State, primarily from Canadian sources.

If you need any further information on this issue, please call

If further space is required please use a second page - Si cet espace est insuffisant veuillez utiliser une deuxième feuille

Signature of person authorizing message - Signature de la personne autorisant l'envoi du message	Telephone no. - N° de téléphone 6-5113
	Date 01 Mar 90

> *so far to collect any evidence that any part of the territory was ever occupied by other tribes. Further inquiry among the Shuswap confirms this. The only part seemingly in doubt is the extreme north, the old Revelstoke band having been much mixed with Shuswap* (Teit 1910-1913).

Further clarification was provided by Teit in the unpublished notes he wrote on the 20th May, 1909:

> *The Kootenay mouth people say emphatically that the Arrow Lake band are their own kin and speak the exact same language as themselves. They have intermarried from time to time with Shuswap and in a less degree with Kootenay. At the present time the Arrow Lake band is made up of some 24 who may be called Lakes and one Shuswap (from Spallumcheen) and one Kootenay (from Kootenay Lake) both women married there making about 26 altogether. They were all mentioned by name to me & some of them are cousins & other relatives to the Kootenay mouth band (the latter number 11 --10 Lakes and 1 Thompson)* (Teit 1909a).

On Teit's unpublished map, the Lakes' homeland was clearly delineated Teit indicated that the Lakes held the country from the area north of Revelstoke, to as far south as Marcus, Washington. He placed the western boundary along the Gold Range, extending south through Grand Forks and including the Kettle River from near Danville down to the area where the Kettle meets the Columbia. The eastern Lakes boundary extended in a northeasterly arc from Marcus, up through the Salmo area and crossing the West Arm of Kootenay Lake between Nelson and Procter. From here, the eastern boundary proceeded north along the divide between Slocan Lake and Kootenay Lake, crossed the Lardeau River immediately north of the upper end of Kootenay Lake, and continued further north along the western side of the Duncan and Beaver Rivers to the Rogers Pass area.

Within this area, Teit (1910-1913) identified the following six areas as the "important old headquarters of the Lakes bands": 1. the vicinity of Nakusp; 2. the southern end of Slocan Lake; 3. the vicintiy of Edgewood; 4. the confluence of Kootenay River with Columbia; 5. the vicinity of Fort Sheperd and Waneta; and 6. the vicinity of Northport.

Concerning the Lakes northern boundary Teit stated:

> *Lakes all country along both banks Columbia...up to beyond Revelstoke.*
>
> *...Only men went above Revelstoke for hunting & trapping - considering near border Shuswap both tribes hunted and trapped River above Revelstoke but Lakes most numerous* (Teit 1909a).

In his May 20th, 1909 letter to Boas, Teit clarified this matter further:

> *They also had no permanent camps north of Revelstoke although they claimed the right to hunt and trap a few miles north of Revelstoke,*

Fisheries
and Oceans

Pêches
et Océans

Pacific Region
Suite 400 - 555 West Hastings St.
Vancouver, B.C.
V6B 5G3

Région du Pacifique
Pièce 400 - 555 rue Hastings ouest
Vancouver (C.-B.)
V6B 5G3

FEB 26 REC'D

75T2-2

Your file Votre référence

Our file Notre référence

8351-1

February 23, 1990

L.M. Churchland, Chief
Water Quality Branch
Inland Waters
Conservation & Protection
Pacific & Yukon Region
502-1001 West Pender Street
Vancouver, British Columbia
V6E 2M9

Dear Dr. Churchland:

ENVIRONMENTAL IMPACT ASSESSMENT - CELGAR EXPANSION

On January 9, 1990 you forwarded for our review the Celgar Environmental Impact Assessment for expansion of the Castlegar pulpmill on the Columbia River.

In the Pacific Region, DFO has an established policy to not directly participate in the review of projects proposed for areas that do not support anadromous Pacific salmon or marine fishes. In keeping with that policy, DFO will not be reviewing the Celgar Expansion EIA.

Yours truly,

S. Samis
Habitat Management Division

cc: M. Nassichuk

Canada

Fred.

United States Department of the Interior

NATIONAL PARK SERVICE

Pacific Northwest Region
83 South King Street, Suite 212
Seattle, Washington 98104

IN REPLY REFER TO:

L7619(PNR-RS)

FEB 28 1990

Mr. Fred Mah
Environment Canada
Water Quality Branch
502-1001 W. Pender St.
Vancouver, British Columbia V6E 2M9

Dear Mr. Mah:

The National Park Service appreciates the opportunity to comment on the Environmental Impact Assessment, Bleached Craft Mill Expansion, Celgar Pulp Company, dated December 1989. We have carried out a review of the document at the request of the Superintendent of Coulee Dam National Recreation Area, located on the Columbia River in the State of Washington, which we believe will be impacted by the mill expansion. Our comments are provided below.

1. (page vii, paragraph 1) The EIA states that "Leachate from the site will be collected in ditches and diverted to an exfiltration basin to prevent the leachate from being directly discharged to the river." The EIA should clarify that, by definition, an exfiltration basin will seep and that, although not resulting in "discharges directly to the river," will likely result in groundwater discharges to the Columbia River. This needed clarification is also applicable to discussions regarding leachate from the existing landfill (see pages 174 and 185).

2. (page vii, paragraph 3) The statement is made that "The reduction in effluent BOD will assure that the dissolved oxygen will stay at acceptable levels under existing river conditions." We do not necessarily believe this will be the case due to the COD (especially in a complex wastewater from the Kraft process).

3. (page vii, paragraph 4) The statement is made that "The solids will also be biodegradable." Where are data that demonstrate this? The statement is also made that these non-settleable biosolids should remain suspended indefinitely in moving water. These two statements seem to be in conflict. How can they be degradable and suspended indefinitely? In addition, we could find no evaluation in the EIA regarding the effect that these non-settleable biosolids will have on downstream waters in the United States.

4. (pages x-xi) The EIA states that "The Celgar Pulp Company will incorporate specific research recommendations into the expansion to reduce dioxin/furan levels." Is this research underway? Will these compounds be carried into waters of the United States? What are the fate and transport studies or models indicating with respect to these compounds? This appears to be a serious gap in the EIA.

5. (page xiii and pages 179-185) In order to sufficiently evaluate the effects of the proposed mill expansion, the water-related monitoring programs recommended in the EIA must be implemented. These programs seem particularly important given the major outstanding environmental questions listed on page 181.

6. (pages 17-18) Given the history of Celgar's various deferrals in meeting effluent requirements, appeals and delays in installing treatment facilities, and requests for variances, what assurance can Celgar give that this history will not be repeated with respect to implementation of environmental controls associated with the proposed expansion?

7. (page 129, paragraph 3) The EIA states that "There is no record of leachate from PR1768 (Power Consolidated (China) Pulp Inc.'s landfill) reaching the river, either directly or indirectly through the groundwater." The EIA does not demonstrate that groundwater in the immediate vicinity of this landfill has been evaluated to detect leachate from the landfill. If this information is available, it should be provided in the EIA.

8. (page 136, paragraph 3) The EIA states that "The probable sink for the ultimate accumulation of some of the fibre is Roosevelt Lake since the Columbia River does not slow down significantly until it reaches this reservoir. However, no studies have been done to evaluate this possibility." The EIA should indicate why these studies (relating directly to the protection of Coulee Dam NRA) have not been carried out.

9. (page 134) With respect to the toxicity of resin acids, are there data on the bioconcentration of these acids by benthic macroinvertebrates (or plankton) and subsequent transfer through the food chain? It also appears prudent to conduct research on the chronic effects of these compounds and relate the information on those compounds and species affected at greater distances downstream.

10. (page 138, paragraph 1) The EIA states that "Interpretation is further complicated since some proportion of the released compounds end up in the sediment and it is not known whether these sediment-bound compounds are available for uptake by aquatic organisms or whether the association with the sediment impedes the breakdown." It is not evident that this "complication" was adequately considered in the conclusions of the EIA with respect to the water-related impacts of the proposed expansion.

11. (pages 144-155) With respect to effluent tests on aquatic species, we have the following questions on test procedures:

    a. Exactly how were the tests done? Were *Daphnia* tested on a single grab sample, on a 24-hr composited sample, on consecutive samples taken daily? Were seasonal samples considered? How many tests were carried out? Exactly which species of "Daphnia" were used?

    b. A 96-hr exposure with groups of fish does not necessarily approximate incipient lethal effects of effluent in an infinitely long exposure time. Rather, it is the asymptote of a toxicity curve over time at which time the line becomes parallel to the axis, and the time could be hours, days, or perhaps weeks depending on the toxicant or toxicants.

    c. If 4-16% wastewater was the 96-hr LC50 to juvenile trout and a conservative acute/chronic ratio was applied of 1/10, the result would be 0.4 to 1.6%. Based on the zone of dilution in the river at low flow, the instream waste concentration is about 0.15% which is not a sufficient margin of safety for chronic effects. Early life stage testing with juvenile fishes should be performed because tests have shown that fish eggs are much less sensitive than the early life stages (larval-juvenile).

    d. Have testing procedures taken into account the different temperature of the wastewater vs. riverwater? Some constituents are much more toxic at higher temperatures than at lower temperatures.

12. (page 147, paragraph 1) The EIA states that the dilutions at the lowest river flows "are many times higher than the LC50 value and provide a substantial margin of protection against acute toxicity in the fish communities of the river." This may in fact be the case, but the EIA fails to assess the indirect, long-term effects of these dilutions on extant fish communities.

13. (page 153, Table 5.20 and page 154, paragraph 3) This table indicates that the expanded mill will result in a 1,200% increase in nitrogen and a 37% decrease in phosphorous. The EIA goes on to state that it is "not possible to predict whether the expected concentration changes (in nutrients) will be significant or which nutrient (nitrogen or phosphorous) is more significant." Given the significance of nutrient loadings to the system, a more complete assessment of this issue should be carried out.

14. (pages 155 and 156) Why is there no evaluation in the EIA with respect to the impacts of total suspended solids (TSS) (which are expected to increase 81%) on aquatic life? Similarly, there is no assessment in the EIA as to the effects of increased TSS and nutrients on downstream water users.

15. (page 163) In regard to bioconcentration of chlorinated organics in clams, we believe that the detection of furans in clams downstream of the mill is of concern. We recommend that a seasonal program be initiated to sample mollusks above and below the mill to determine fluctuations of the organics with temperature. Mollusks store most chlorinated organics in eggs and most are eliminated with spawn. Unless seasonal reproductive cycles, tied to temperature regimes, are recorded, comparisons are difficult to interpret. Clams are preferred to fish because they are immobile.

16. (page 170) With respect to the reduction in chlorinated dioxin/furans, we believe that a study should address the potential for furans/dioxins to partition towards lipophilic substances (i.e., n-octanol-water partition coefficients) for each of the compounds. The reason for this is that furans/dioxins may sorb onto the biosolids, be eaten by mysids which are tactile eaters and are subsequently eaten by fish.

Please continue to coordinate this project with the Superintendent of Coulee Dam National Recreation Area, at P. O. Box 37, Coulee Dam, Washington 99116.

Again, thank you for the opportunity to provide our comments on the document.

Sincerely,

Charles H Odegaard

Charles H. Odegaard
Regional Director

cc:
Superintendent, Coulee Dam National Recreation Area

FEB 2 RECD
7572-2

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
N. 4601 Monroe, Suite 100 • Spokane, Washington 99205-1295 • (509) 456-2926

February 22, 1990

Environment Canada
Water Quality Branch
Inland Waters
Pacific & Yukon Region
Conservation and Protection
502-1001 West Pender Street
Vancouver, B.C. V6E 2M9

Att: Mr. Fred Mah

Subject: Environmental Impact Assessment - Celgar Expansion

Dear Mr. Mah:

I want to thank you for providing the department with the opportunity to review and comment on the proposed expansion of the Celgar Pulp Company. The proposal to replace the existing Kraft Pulp Mill with new pulping and bleaching technology and to construct a biological wastewater treatment system will go a long way toward improving the water quality in the upper Columbia River for persistent chlorinated organic compounds. The design of the new equipment should be scrutinized to ensure that adequate capacity for proper delignification, chemical recovery and chlorine dioxide substitution are built into the process. It is noted that the biological treatment system is proposed to be built in an abandoned rock quarry. To insure adequate treatment of the wastewater, this area needs to be properly sealed to prevent seepage. I regret that we were unable to spend as much time as we would have wished in review of this project. Based on this, our comments will be somewhat general in nature but we wished to remain involved in the evolution of this project with hopes of more detailed review as it proceeds. Our comments are as follows:

We believe that the incorporation of Level A emission standards should be a mandatory minimum requirement for treatment of the Celgar discharges. This treatment level should then be evaluated against potential water quality impacts and refined where necessary to protect water quality. These discharge standards along with detailed inplant and instream monitoring should insure that water quality is protected.

We also agree that monitoring of the discharge along with measuring river water quality is an important step to initiate immediately. This will provide background data and will evaluate the impact to the Columbia River through the construction period and after the new system comes on line.

This instream study area, just down to the Kootenay River, is probably justifiable for conventional pollutants only.

Instream studies for toxic compounds, (ie. AOX, Dioxins and Furans), whether directly or through bioaccumulation studies should be expended outside the above mentioned study area. This study area should, at a minimum, extend to the U.S./Canada border. It may be valuable to work even further down the Columbia in joint projects with our department or other groups studying this reach.

The requirements for a dilution zone study are also important. Biomonitoring of the effluent along with chronic bioassays at the edge of the dilution zone should be a requirement. The incorporation of a benthic diversity study before and after the upgrade should also be included. This should probably be started this year with follow-up studies every 3-5 years to help determine any benefits from the proposed improvements.

Again I want to thank you for providing our agency the opportunity to comment on this project. We do with to remain involved and would be interested in commenting further if additional time is provided. Please keep us advised as to the progress of this project.

Sincerely,

James B. [illegible]
for
Carl J. Nuechterlein
Section Supervisor
Water Quality Section

cc Rick Albright, USEPA, Seattle
Stan Springer, Ecology, Olympia
John Arnquist, Ecology, Spokane
R.J. Crozier, Ministry of Environment, Province of British Columbia
Dick Burkhalter, Ecology, Olympia
Phil Kauzloric, Ecology, Olympia

United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

Alaska
Idaho
Oregon
Washington

EPA

FEB 23 1990

FEB 26 REC'D
7572-2

Reply to
Attn of: WD-139

L.M. Churchland, Chief
Water Quality Branch
Pacific & Yukon Region
Conservation and Protection
502 - 1001 West Pender Street
Vancouver, B.C. V6E 2M9 Canada

RE: Environmental Impact Assessment (EIA) for Celgar Pulp Mill Expansion

Dear Ms. Churchland:

Thank you for the opportunity to provide comments on the EIA for the proposed expansion of the Celgar Pulp Mill in Castlegar, B.C. Recent findings of elevated dioxin and furan levels in fish from Lake Roosevelt and ongoing concerns over nutrient inputs to the lake have created a great deal of interest in the U.S. concerning the project.

While there is little doubt that the planned upgrade of pollution control facilities to meet Level A environmental criteria will reduce discharges of most pollutants, our concern is whether the proposed actions will eliminate the mill's contribution to water quality problems in U.S. waters.

The upgraded mill will be capable of extended delignification, oxygen delignification, high (70%) chlorine dioxide substitution, and oxygen extraction. In addition, the Celgar mill already has high shear mixers and has eliminated additives, such as defoamers, which contain dioxin and furan precursors. These process changes, combined with effluent limitations on the production of chlorinated organic compounds (measured as AOX), are equal to or more stringent than limits being place on U.S. mills, and should result in discharges of dioxins and furans below current detection levels. The proposed monitoring plan should help verify the adequacy of these controls. Monitoring of dioxins and furans in the interal bleach plant wastestream will provide a much more sensitive measure of dioxin and furan production, and is strongly recommended. The only additional process that should be considered is peroxide reinforcement in the oxygen extraction stage. This addition will further reduce the chlorine demand and subsequent production of chlorinated organic compounds.

Evaluation of the adequacy of nutrient controls is more difficult. Because of the relatively rapid flow of the Columbia River downstream to the Canada - U.S. border, excessive growths of periphyton, macrophytes, or plankton would be less likely than in the slow-moving waters of Lake Roosevelt. Recent reports of mill foil growth in Lake Roosevelt may be an indication of excessive nutrient loading to the lake. A better description of changes in nutrient loadings to the Columbia River after plant expansion is needed, along with estimates of loadings from the Kootenay River and the Columbia River above the Celgar Pulp Mill. In the absence of a more definitive discussion of nutrient effects on Lake Roosevelt, we continue to have concerns in this area.

There has been a great deal of confusion concerning the U.S. Food and Drug Administration's (FDA) supposed finding that edible portions of fish containing less than 25 ppt of 2,3,7,8 - TCDD may be eaten without an unacceptable health risk. This FDA number was developed to regulate interstate commerce of contaminated fish from the Great Lakes. Inherent in the analysis is the assumption that only 10% of the fish consumed (through interstate commerce) are contaminated. Because only 10% of fish were assumed to be contaminated, those fish that are contaminated may contain a higher concentration of dioxin. Thus, the FDA numbers are inappropriate for use to protect groups consuming large quantities of locally caught fish (such as recreational fishermen, native Americans, and certain Asian populations). FDA itself has concurred that their numbers are not appropriate for making water quality decisions.

The total reduced sulfur (TRS) emissions from the proposed Celgar mill expansion exceed EPA New Source Performance Standards (NSPS) as follows:

Source	Proposed TRS Emissions	EPA NSPS
Recovery Furnace	6.5 ppm	5 ppm[1]
Lime Kiln	10 ppm	8 ppm[2]

Furthermore, NSPS require continuous monitoring of TRS emissions from these sources.

In addition, recent Best Available Control Technology determinations have been proposed in Oregon (contact Bill Fuller at the Oregon Department of Environmental Quality for further information at (503) 229-5749). Based on these determinations, the SO_2 emissions limit on the Recovery Furnace could be reduced from Celgar's proposed 350 ppm to 60 ppm (3 hour average). The 350 ppm is Celgar's proposed short-term limit; their long-term average is proposed to be 100 ppm.

---

[1] Dry basis corrected to 8% of 12 hour average

[2] Dry basis corrected to 10% of 12-hour average

A number of other issues and questions arose during staff review of the EIA. Rather than reiterate these concerns, I am enclosing marked up copies of the appropriate pages from the EIA.

Again, thank you for the opportunity to review this project. We commend the recent actions by Environment Canada and the B.C. Ministry of Environment to control discharges of pollutants from pulp mills, especially with respect to discharges of chlorinated organic compounds.

Sincerely,

R. Albright

Richard Albright
Regional Toxics Coordinator

Enclosure

Conventional bleaching involves chlorine addition to the pulp to react with lignin not yet removed from the pulp fibres. The chloro-lignin compounds are subsequently removed in the caustic extraction stage. Substitution of chlorine dioxide for chlorine in the lignin extraction stage results in a substantial reduction in chlorinated lignin production. Chlorine dioxide substitution is defined as the percentage of equivalent chlorine used in the form of chlorine dioxide in the chlorination stage (Bonsor et al., 1988). The proposed changes in chlorine use will result in a corresponding reduction in organochlorines produced, and in particular, dioxins and furans will be reduced to below current limits of detection.

What is the
water qua'
criterion in
Canada? Is
below detection
adequate to ens
the criterion
met?

The expected effect of these new steps in the pulping process are summarized in Table 3.3.

The proposed mill will also include steam stripping of foul condensates generated in the digesters and evaporators. If the foul condensate remained in the effluent, it would contribute to the BOD_5 load and toxicity. The main organic constituents of foul condensates are methanol, ethanol, turpentine, hydrogen sulphide and organic sulfides that will be removed in a steam stripping column integrated into the evaporator train. Overhead gases from the stripper will be condensed and decanted to recover available turpentine (which may be sold or burned). The non-condensable gases will be burned in the lime kiln.

3.1.3.2 External Spill Control Systems

Recycling of spilled material in the processing area allows for the recovery of economically valuable material. It also protects the effluent treatment system from shock loads of high strength waste, or low pH for example, which could kill the biomass in the treatment system, and result in untreated effluent being discharged to the river. Spill control systems are designed for the processing areas, and a 24 hour emergency spill basin is being incorporated into the effluent treatment plant to augment in-plant systems for spill containment. When conditions return to normal, the contents of the basin can be pumped to the treatment system at a controlled rate. There are no plans to collect storm water on the mill site.

The combined mill effluent pH can vary widely. Celgar recently installed a neutralization system in the existing mill which uses lime mud or lime slurry from the lime kiln scrubber to neutralize the acid in the sewer. A similar system is proposed for the expanded mill, possibly using the existing equipment relocated to another site. However, since the new kiln will have an electrostatic precipitator rather than a scrubber, lime slurry will not be available so the underflow from the recausticizing effluent clarifier will be used to raise the pH. The lime mud storage will provide an alternate supply of lime mud.

To ensure complete reaction of the lime slurry with the acid effluent, the acid sewer is held for about 6-10 minutes in two mix tanks in series before mixing with the bleach plant alkaline sewer and general sewer. Lime addition is automatically controlled to maintain a combined effluent pH of 6.5-8.0. Should the combined effluent rise above the upper acceptable pH limit of 8.0, the power house control room will be automatically alerted to add more acid from the spent demineralizer acid tank to the sewer.

Acid effluent from regeneration of the demineralizers used to treat boiler feed water is discharged intermittently in large quantities throughout the day, contributing significantly to pH swings in the combined effluent. The acid will be collected into a tank and released at a uniform rate into the general sewer where appropriate neutralization will occur. During some semi-bleached pulp runs and bleach plant shutdowns, the pH of the combined effluent rises above the acceptable maximum of 8.0. A provision will be made to add acid to the effluent in order to control pH within the desired range. The alkaline sewer receives filtrate from the extraction stage washers, and is combined with the acid sewer at the pumping station.

Cooling Water

Approximately 39-50% of the total effluent flow (i.e., about 30,000 m^3/d in winter and 46,800 m^3/day in summer) will be clean water from cooling equipment such as the chlorine dioxide plant water chiller and barometric condenser, the air compressor cooler, the turbo generator, recovery boiler fan, motor control centres and surface condensers. This warm water is uncontaminated and will be collected in a dedicated pipeline. It will bypass the effluent treatment system and go directly to the foam tank where it will mix with treated effluent from the biological treatment system. The combined effluent will discharge to the Columbia River through the existing diffuser.

Are any biocides or conditioners used ?

5.1.4 Other Man-Made Activities

Other activities in the reach of river from the dam to the confluence which may affect river water quality are the Hugh Keenleyside Dam and moving/storing logs on the river.

- The Hugh Keenleyside Dam. The operation of the Hugh Keenleyside Dam has resulted in dissolved gas supersaturation (oxygen and nitrogen) in the Columbia River downstream from the dam. Water discharged through the dam must either pass through eight low level ports or over a four gate sluiceway and into an energy dissipator before entering the discharge channel. When water is discharged over the sluiceway, air is entrained in the water as it plunges into the energy dissipator. Other effects include prevention/ of fish movement past the dam, modification of nutrient inputs, and as a reservoir supply of zooplankton (mysids) which may contribute to fish feeding downriver.

- Both the nearby upstream sawmill and the Celgar Pulp mill have used the river for log transportation. When the woodroom re-opens, the pulp mill may use the foreshore area in front of the mill for log storage. This will be in the approximate area where log storage has occurred in the past, on the south shore of the river surrounding the outfall. Diver studies have observed sunken logs, bark and wood debris on the river bottom. Studies of log storage in freshwater lakes have identified logs and log debris as a source of BOD, colour and toxicity to the water column (Hall et al., in press; Jackson, 1986).

will log storage be permitted activity?

5.1.5 Fisheries Resources

The fish species in the Columbia River from the Hugh Keenleyside Dam to Trail were examined as part of an environmental impact assessment for B.C. Hydro (R.L. & L. Consultants, 1984a). The common and scientific names of the species present in the area, and their contribution to the total catch in samples taken by R.L. & L. Consultants (1984a) are given in Table 5.4. The fish assemblage is dominated by suckers and minnows, which account for >90% of the catch, although the sampling methods used may have underestimated the abundance of larger, open-water species (e.g., rainbow trout). Several species (brook trout, walleye, carp) have been introduced, but were not yet abundant in 1984. However, R. Crozier (1989) reports that now walleye are quite abundant and sturgeon are caught in the vicinity of the mill. Chinook salmon were not captured in samples during the R.L. & L. Consultants (1984a) survey, but have been caught by anglers. These salmon presumably originate from plantings in Lake Roosevelt, south of the Canada-U.S. border.

Rainbow Trout

Rainbow trout (*O. mykiss*) occur in the mainstem Columbia River and in tributaries. Fish resident in the tributaries are small, and probably do not contribute to the fishery (R.L. & L. Consultants, 1984a). Fish in the mainstem are most abundant between the Hugh Keenleyside Dam and Castlegar. Rainbow trout are found in slower reaches and eddies, which tend to be favoured fishing spots. The locations of major rearing and feeding areas are given in the resource atlas prepared for the Murphy Creek environmental impact assessment (Thurber Consultants, 1981). Local anglers report that emerging aquatic insects are the most important food item in the summer and fall; mysids from Lower Arrow Lake are also probably important, although R.L. & L. Consultants (1984a) were unable to examine feeding in detail (most fish were tagged and released).

Why are trout less abundant downstream Castlegar ?

Rainbow trout spawn in a number of tributaries in the study area, the most important of which is Norns Creek (R.L. & L. Consultants, 1984a). Spawning also occurs in the Columbia and Kootenay mainstems (R.L. & L. Consultants, 1984b, 1985), but the numbers of spawners are unknown. Spawning in Norns Creek occurs in April and May, with approx. 100-200 spawners estimated for 1981-1984 (R.L. & L. Consultants, 1984a,b, 1985). Rainbow trout are the most important sport fish in the area, in terms of both angler preference and estimated annual catch (2000) (B.C. Fish and Wildlife Branch, 1981; R.L. & L. Consultants, 1984a). Average catch-per-unit effort (CUE) was 0.18/rod h, which is high for a large exploited river, but lower than in other less exploited B.C. rivers.

Dolly Varden Trout

Dolly Varden trout (*Salvelinus malma*) are rare in the study area, and may be remnants of a former riverine population that existed prior to the construction of the Hugh Keenleyside Dam (Ash et al., 1984a). The presence of some younger fish indicates that some recruitment must occur, either from Lake Roosevelt, the Arrow Lakes, or some as yet unidentified tributary in the study area. Although angler catch/unit effort is low (<0.03/rod h) for Dolly Varden, they are sought after because of their large size (B.C. Fish and Wildlife Branch, 1981). Estimated annual catch is <100.

Major Non-Sport Fish Species

Suckers

The biology of suckers, which are of no importance in the sport fishery, is described because these species can be useful for monitoring toxicant levels and effects. Catches for the three species were pooled in Table 5.4 because the young could not be identified to species by R.L. & L. Consultants (1984a). Among adults, the largescale sucker was the most common, accounting for 67% of the identified suckers. Longnose suckers accounted for 30% and bridgelip suckers 3%. Longnose suckers were captured primarily in the slow-flowing upper reaches of the Columbia River, whereas largescale and bridgelip suckers were captured more frequently in the faster reaches downstream from Castlegar. All three species are bottom feeders.

All three species spawn in the spring, with longnose suckers spawning approximately 1 month earlier than largescale suckers (R.L. & L. Consultants, 1984a). Spawning usually occurs over gravel (Scott and Crossman, 1973). Juvenile suckers were abundant along the shoreline of the mainstem Columbia River, and were also found in Norns Creek (R.L. & L. Consultants, 1984a).

Redside Shiner

Redside shiners (*Richardsonius balteatus*) are most abundant upstream of Castlegar, in low gradient reaches (Ash et al., 1984). Spawning and rearing habitats are unknown, although suitable habitats are certainly present in the upper reaches of the mainstem Columbia River. Adults feed on insects, fish eggs, and small fish, and can be a minor predator on, and major competitor with, young trout (Scott and Crossman, 1973). As the most abundant fish in the study area, redside shiners are undoubtedly an important food source for the larger piscivorous trout, walleye, burbot, and squawfish.

5.1.6 Water Quality Objectives

Section 3 dealt with effluent discharge levels as set by the 1977 MOE document "Pollution Control Objectives for the Forest Products Industry of British Columbia" (Table 3.2). Effluent objectives were defined by MOE in 1977 on a unit production basis (per air dried tonne of pulp) for the discharge of BOD$_5$ and suspended solids. Limits were also set on the effluent temperature, pH and level of toxicity. In May of 1989, a limit on the quantity of AOX (chlorinated organics) per ADt was announced by the B.C. Environment Minister.

As well as defining effluent quality objectives on a production (ADt) basis, the document also listed receiving Water Quality Objectives (Table 5.5). In setting the receiving water quality objectives, the MOE (1977b) recognised an initial zone, in the area of the discharge, where the wastewater would be diluted. This initial dilution zone is allowed to extend up to 50% of the width of the river body and up to 100 m downstream of the outfall. The distance of 100 m is arbitrary and not related to the hydraulic characteristics of the receiving water body. The initial dilution zone is not subject to receiving water quality guidelines.

If this is the allowable dilution zone, why is there so much discussion about complete mixing 450-600 m downstream, and dilution from the Kootenay River ?

Table 5.5 Receiving water quality objectives[1]. From MOE Forestry Objectives (1977b).

Characteristic	Objective
Dissolved oxygen	negligible change[4]
Toxicity	no increase
pH	negligible change
Residual chlorine	below detectable limits (amperometric method)
Turbidity (APHA units)	negligible change
Oil	none visible on water surface
Floatable solids, scum	negligible increase
Temperature (°C)	no measurable change
Foam	no increase
Nutrients[2]	negligible change in site specific productivity limiting parameters
Primary production[3]	negligible change
Tainting, edible organisms	no change
Colour (APHA units)	negligible increase
Suspended Solids	negligible increase
Phenol	negligible increase
Mercaptans	negligible increase
Sulphides	negligible increase
Resin acids (total)	negligible increase
Biocide additives	no measurable increase
Woodwaste leachates	negligible increase
Aesthetic	no decrease

---

1. Not applicable in the initial dilution zone.
2. Nutrients - limiting parameters will normally be taken as phosphates and/or biologically assimilative nitrogen compounds.
3. Primary production - biological growth directly dependent on sunlight.
4. A negligible change (increase or decrease) is one which does not lead to a polluted condition in receiving water quality and can therefore be disregarded.

Very vague.

Do these include drinking water standards?

Other government agencies have also published water quality objectives, according to intended use. Table 5.6 lists water quality objectives adapted from different sources for applicable parameters discharged by the mill. The complete tables of Water Quality Objectives are listed in Appendix 5. Table 5.6 is a summary to show the most stringent levels for various intended uses.

5.2 Existing Mill Effluent Discharge

The existing mill's effluent is reviewed in terms of physical and chemical characteristics; impact on water quality, benthos and fish; and consequences for human use.

5.2.1 Initial Dilution Zone

The existing outfall diffuser is 60 m long and is located on the river bottom at a water depth of 15 to 25 meters. Figure 5.3 is adapted from the Phase II Kootenay report (MOE, 1979), and based on the low flow condition (142 m^3/s) and the existing mill discharge, shows that the dilution is approximately 65:1 at the end of the initial dilution zone. At average flow conditions in the Columbia River this dilution would be 1008:1.

does this take into account when there's a hydraulic da

Aerial photographs taken on May 22, 1977 when the flow in the Columbia river was at 149 m^3/s, showed that the plume surfaced within 40 meters of the diffuser. The plume was about 50 meters wide and then spread to widths of 100 meters at a distance of 100 meters downstream of the outfall. The plume impinged on the south shore of the river 450 to 600 meters downstream. The distance required to achieve complete mixing is not known, but mixing should be complete once the water enters Castlegar Narrows, 4 km downstream from the Castlegar Mill (MOE, 1979).

Does this mean that outside the dilution zone receiving water standards for colour are exceeded?

5.2.2 Dilution of Mill Effluent (Upon Complete Mixing)

The mean annual discharge of the Columbia River flowing past the pulp mill (upstream of the Kootenay River confluence) is 1144 m^3/s (MOE, 1977b, 1979, 1984; Dwernychuk, 1989). Today, the effluent flow rate is approximately 1134 m^3/s, so the average dilution ratio is 1009:1. The normal minimum flow in this reach of the Columbia River is 142 m^3/s, so the minimum effluent dilution is 125:1 upon complete mixing. Such low flows are observed about 4% of the time i.e., 13-15 days a year (MOE, 1979).

Do any of the standards rely on complete mixing or is this info. just tossed in?

MOE (1984) reported of instances where the hydraulic damming of the Columbia River by the Kootenay River has caused the Columbia River flow at the mill to reverse direction. MOE carried out measurements of various river characteristics in the vicinity of the Celgar Pulp Mill. Results showed that the river flow conditions prevented plume dispersion. Observations indicated that approximately four (4) days were required for the river to gain sufficient head to break down the hydraulic dam. However, no detailed hydraulic studies have been done on the effluent mixing pattern with the river water, under these conditions.

What effect does this have on receiving water quality D.O.? colour toxicity etc.

5.2.3 Physical/Chemical Changes to the Columbia River

Detailed effluent discharge characteristics (aside from Permit requirements) has not been measured regularly since the mill first became operational. Table 5.7 summarizes mill effluent characteristics as was measured in 1975. Since then the mill has altered the discharge quality with pH control, a reduction in suspended solids and closure of the woodroom. These changes are reflected in results of a 1988 sample of the effluent (see Table 5.8).

The results of the 1988 grab sample results (Dwernychuk, 1988), are used to predict the expected change in the Columbia River water quality, when flowing at 142 m^3/s (low flow). Table 5.9 shows the calculation results of the expected change to water quality just outside the initial dilution zone and upon complete mix.

Only one low flow (142 m^3/s) study of river water quality has been carried out to assess the effect of the pulp mill when the river's dilution capacity is lowest (by MOE, 1984). MOE samples indicated increased phenol levels for one day of the three days of testing and a measurable increase in colour, for the entire study period, as shown in Table 5.10.

Dwernychuk (1988) sampled the mill effluent and receiving waters upstream and downstream of the mill and the results are shown in Table 5.8. The location of Stations 1N, 2N, and 4N, 4S are shown in Figure 5.4. During sampling, the Columbia River discharge was at 420 m^3/s. The river dilution capacity was estimated to be 370:1 for this river flow. 4N and 4S outside the initial dilution zone, were not likely be completely mixed (Figure 5.4). The results shown in Table 5.9 are within levels predicted for dilution under these flow conditions.

In 1982/1983, B.C. Hydro conducted river water quality tests on the Columbia River. Sampling was carried out at three stations: Station 0200183 is above the pulp mill outfall; Station 0200178 which is at the mouth of the Kootenay River as it joins the Columbia River; Station 00200003 is the Birchbank Station, 16 kilometres downriver from the confluence of the Kootenay and Columbia River (and approximately 26 kilometres downriver from the Keenleyside Dam). Sampling results are

Table 5.7 Summary of Celgar effluent quality for June 1970 to 1977 (from MOE, 1979).

CANADIAN CELLULOSE CO. LTD.
SUMMARY OF EFFLUENT DATA OBTAINED BY THE COMPANY AND THE PROVINCE FROM JUNE 1975 TO MAY 1977

Sampling Site		Combined Pulp Mill and Woodroom Effluent	
Parameter	Type of Value	Range	Mean (No. of Values)
BOD_5	mg/L	105-536	195 (18)
	t/d	14.2-33.2	22.7 (28)
Carbon, Total Organic	mg/L	137-621	275 (18)
Chlorine Residual	mg/L	0-3.4	0.24 (77)
Coliforms, Fecal	M.P.N./ 100 mL	<200-<2000	(5)
Color, True	Color Units	440-4000	94(1251)
Flow	10^3 m^3/d	41-152	119(480)
Mercaptans	mg/L	0-28.8	3.0(71)
Nitrogen, Kjeldahl	mg/L	1.0-6.0	2.3(17)
Nitrite + Nitrate	mg/L		0.44(1)
Oil and Grease	mg/L	5-205	33(16)
Oxygen, Dissolved	mg/L	0-12.4	2.0(598)
pH		2.6-11.5	5.4(499)
Phenols	mg/L	0.35-3.7	1.3(18)
Phosphorus, Ortho phosphate	mg/L	0.45-1.3	0.74(17)
Total	mg/L	0.27-1.9	1.0(18) — total phosphorus ?
Resin Acids	mg/L	0.4-14.0	3.0(76)
Solids, Dissolved	mg/L	979-2316	1340(14)
Floatable	mg/L	0	0(518)
Settleable	mg/L	1.2-650	16.7(81)
Suspended	mg/L	69-427	180(17)
Sulphides	mg/L	0-37.6	2.0(82)
Tannin and Lignin	mg/L	50-280	135(18)
Temperature	°C	13-41	32(508)
Toxicity (96-h LC50)		7.5-35	19.0(8)

Table 5.8 Detailed effluent and receiving water quality analysis June 22, 1988; Celgar Pulp Company (Dwernychuk, 1988)[1].

Parameter	Receiving Water Upstream 1N[3]	Receiving Water Upstream 1S	Celgar Effluent	Receiving Water Downstream 4N	Receiving Water Downstream 4S
Physical Tests					
Water Temp. (°C)	15.0	15.0	28.0	15.0	15.0
pH	7.73	7.73	6.62	7.91	7.88
Conductivity (μmho)	112.0	112.0	1010.0	106.0	101.0
Colour (TCU)	8.0	8.0	870.0	7.0	11.0
Turbidity (NTU)	L1.0	L1.0	8.6	L1.0	L1.0
Suspended Solids (mg/L)	L1.0	L1.0	48.0	L1.0	L1.0
Dissolved Oxygen (mg/L)	12.0	11.9	3.3	11.6	11.5
D.O. Saturation (%)	124	123	42	120	119
Anions & Nutrients					
Alkalinity (mg/L as $CaCO_3$)	53.3	54.3	95.5	54.3	54.3
Chloride (mg/L)	L0.50	L0.50	1440.0	L0.50	L0.50
T-Phosphorous (mg/L as P)	0.013	0.014	0.50	0.006	0.010
Total Kjeldahl (mg/L as N)	0.13	0.21	1.31	0.15	0.14
Other Tests					
BOD_5[2] (mg/L)	1.0	1.2	111.0	1.3	1.5
Phenol (mg/L)	-	L0.002	2.48	-	L0.002
Tannins & Lignins (mg/L)	0.10	0.12	110.0	0.14	0.39
Sodium (mg/L)	0.92	0.86	180.0	0.94	1.33

L = Less than.
T = Total.
D = Dissolved.

1. Discharge in the Columbia River for this day was at 412 m^3/s.
2. BOD_5 = 5 Day Biochemical Oxygen Demand.
3. Stations locations are shown in Figure 5.4.

Those stations are almost at the confluence of the Kootenay should be station at edge of dilution zone.

le 5.10 Columbia River receiving ter characteristics at low flow (142 m^3/ ,MOE, 1984)[2].

Site	Parameter	Units	June 12 AM	June 12 PM	June 13 AM	June 13 PM	June 14 AM	June 14 PM
0200183 Columbia River Between Dam & Celgar Pulp Mill (Control Station)	pH	rel. units	7.7	7.8	7.9	7.9	7.4	7.9
	res. N-Filt.	mg/L	2.0	2.0	1.0	1.0	4.0	1.0
	sp. cond.	μmhos/cm	128.0	128.0	126.0	126.0	126.0	125.0
	colour:SWL[1]	SWL	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	phenol	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
0200604 Columbia River @ Castlegar Ferry North Side	pH	rel. units	7.9	6.7	7.6	7.6	7.5	7.6
	res. N-Filt.	mg/L	2.0	-	6.0	5.0	4.0	2.0
	sp. cond.	μmhos/cm	128.0	132.0	144.0	145.0	144.0	145.0
	Colour SWL	SWL	<5.0	9.0	32.0	32.0	35.0	35.0
	phenol	mg/L	<0.002	0.004	0.002	<0.002	<0.002	<0.002
1190074 Columbia River @ Castlegar Ferry South Side	pH	rel. units	7.8	7.8	-	7.6	7.5	7.5
	Res N-Filt.	mg/L	2.0	5.0	-	2.0	3.0	2.0
	sp. cond.	μmhos/cm	137.0	137.0	-	145.0	144.0	142.0
	Colour SWL	SWL	12.0	14.0	-	32.0	41.0	32.0
	phenol	mg/L	0.008	0.007	-	<0.002	0.004	<0.002
0200200 Columbia River at Castlegar	pH	rel. units	7.7	7.8	7.6	7.3	7.6	7.7
	res. N-Filt.	mg/L	3.0	3.0	5.0	7.0	2.0	2.0
	sp. cond.	μmhos/cm	125.0	128.0	123.0	127.0	123.0	127.0
	colour SWL	SWL	11.0	15.0	19.0	23.0	19.0	20.0
	phenol	mg/L	0.005	0.006	<0.002	<0.002	<0.002	0.002

where are data for the edge of the dilution zone?

---

1. Colour measurement was done by measuring the absorbance of the sample at a single wavelength. Where pulp mill effluent is the major colour influence, single wavelength colour (measured at 465 mm) is approximately equivalent to total absorbance colour (TAC) (MOE, 1984).

2. Station locations are shown in Figure 5.4.

shown in Table 5.11, the stations shown in Figure 5.4. Water quality at Birchbank reflect the changes from the inflow of both rivers as well as the discharges into the Columbia River. This includes not only the Celgar Pulp Company but also those dischargers listed in Table 5.1 including the City of Castlegar. A review of the Water Quality Objectives (Table 5.6) indicate that on average all three stations have acceptable values.

The most detailed monitoring program of water quality was carried out by MOE between 1975 and 1977. Testing was carried out at Stations 200183 and 0200178, but sampling also included an additional station (0200200). This station is between the mill site and the confluence of the Kootenay, where the effect of the Celgar Pulp Mill is more readily observed (Table 5.12). The mill has since introduced a number of changes, to improve the quality of the effluent discharge, but the data indicates past problems and areas of concern that the expanded pulp mill is addressing.

Why is the effect of the mill more readily seen here? (See comment on P. 111)

Pulp mills are generally not known for problems with elevated metal levels and the levels of metals were all within recommended values.

Dwernychuk (1988) concluded that mill effluent at the time of his study, with the Columbia River discharging at 412 m^3/s, had a negligible effect on temperature, pH, suspended solids, alkalinities and total Kjeldahl nitrogen. Conductivity and chloride, total phosphorous concentrations did show slight increases immediately downstream of the discharge but the values dropped to near background (except for total phosphorous, due to a source other than the Celgar pulp mill). Colour, dissolved oxygen, BOD_5, tannin/lignins, sodium and resin acids all exhibited noticeable changes downstream of the discharge.

5.2.4 Effluent Discharge Parameters

Using the data summarized on the previous pages, parameters of concern from the discharge effluent, with their effect on the physical/chemical environment of the Columbia River are discussed in detail below.

BOD and Dissolved Oxygen

The BOD content of an effluent is a measure of the oxygen required to biologically degrade the organic material in the effluent. Dwernychuk (1988) indicated that conditions in 1988 were similar to those observed in 1977 by MOE. The mill has continually released effluent with a daily load in excess of 18,000 kg BOD_5 and a dissolved oxygen content less than 5.0 mg/L. However, the river's dissolved oxygen level has never been observed to drop below 9.0 mg/L downstream of the Celgar Pulp Mill. This is because the river has the capacity to assimilate the waste discharge, partly due to downstream of the outfall (MOE, 1977a, 1989a; Kinrade, 1986) to address this issue. All studies reported the presence of a fibre mat on the south side of the river, near the diffuser's location, approximately 3.3 km downstream from the Hugh Keenleyside Dam.

In the 1975 study (MOE, 1977a), the river bottom immediately downstream of the diffuser, was covered by a fibre blanket 0.6 to 1.0 m thick extending approximately halfway across the river from the south shore and approximately 0.97 km downstream. Beyond this area, the river bottom showed little visible impact from the mill, having a heavy growth of aquatic plants harbouring invertebrates and fish. This was similar to the vegetation growth observed upstream of the outfall and on the north side of the river (MOE, 1977a). At the outfall, the effluent pipe was covered by 15 to 30 cm of black ooze (suspended flyash).

does MOE have any standards for zones deposit?

The 1986 survey (Kinrade, 1986) revealed the mat had changed since 1977, which may reflect the fact that the fibre load discharged to the river was reduced by the mill. Within a distance of one km away from the outfall, the river bottom had three distinct zones. From the south shore, the first third of the river width had a 1-2 cm thick mat covering all 1-2 meter diameter rocks. The mat consisted of 1-2 cm long fibres mixed with algae. No samples were analyzed to determine the composition of the mat, but divers described the bottom of the river as being composed of fibre and flyash. The second one third of the traverse was a clear sandy bottom with material accumulating in large depressions in the sand. Black flyash material was evident in this region settling in small pockets and ripples in the sand. The fibre mat reappeared in the final one third. The fibres were still 1-2 cm long but was not as thick as was observed on the south side. Kinrade (1986) concluded that the terrain of the river bottom was a definite factor in build up of the mat. They theorized that the fine sand offered no resistance to the river flow and was not a stable substrate for the fibre buildup. The velocity of the river also contributed in keeping the fibre suspended in the stream until such time as it settled out due to a drop in river velocity. The probable sink for the ultimate accumulation of some of the fibre is Roosevelt Lake since the Columbia River does not slow down significantly until it reaches this reservoir. However, no studies have been done to evaluate this possibility. The 1986 observations (Kinrade, 1986) indicated that the mat is not as thick as it was in 1975, but spread over a much larger area.

& dioxin?

In 1989, MOE (1989a) described features similar to 1986 on the river bottom including black flyash material trapped in the river bottom sand. Within 300 m downstream of the mill, the mat was described as soft grey, underlain by black material. The south side of the river was an old booming area. Such activity has resulted in the build up of sunken logs, bark and other debris associated with log handling and storage. The black material, which looked like rotting wood and sawdust, and could be remnants of past log handling activity. Figure 1.3 shows this zone of impact from logging activity.

As shown in Table 5.9, the total phosphorous should change by +0.008 mg/L (outside the initial dilution zone) and drop to +0.003 mg/L with complete mixing. Upstream levels have been recorded as high as 0.026 mg/L total though on average, this value has been reported at 0.007 mg/L. Dwernychuk (1988) showed that phosphorous from the mill increased phosphorous levels in the river by less than an order of magnitude. Nitrogen (measured as total Kjeldahl nitrogen) levels were not significantly altered by the pulp mill.

[illegible] & [illegible] change

Temperature and pH

With the installation of a neutralization system, the mill effluent does not affect the river pH. Local river water temperature changes were not observed by Dwernychuk (1988). With an average effluent temperature of 27.4°C, at river low flow (142 m^3/s) the temperature increase may increase by 0.4°C (outside the initial dilution zone), and upon complete mixing, changes would not be detectable.

However, this assumes that the effluent discharge mixes with the river to allow for rapid heat transfer. No studies have been conducted during winter when river water/effluent temperature difference would be greatest.

Klebsiella Pneumonia

Klebsiella pneumonia is a common bacteria in pulp mill effluent; it occurs naturally in bark and wood, as well as being widely distributed in humans. *K. pneumonia* can show a false positive response to fecal coliform tests, which are used as an indicator of human wastes. Under certain conditions, primarily in hospitalized patients, *K. pneumonia* can be pathogenic causing pneumonia and genito-urinary infections. However, there is no evidence that these infections are waterborne. Canadian Water Quality Guidelines (CCREM, 1987) do not list *Klebsiella* as a pathogen of concern.

Organic Compounds in Mill Effluent

The principal concerns with chlorinated and unchlorinated organic compounds in bleached kraft mill effluent relate to acute and chronic aquatic toxicity, bioaccumulation of chlorinated organic including polychlorinated dibenzo-dioxins (PCDDs) and poly-chlorinated dibenzofurans (PCDFs), and taste and odour in fish flesh.

Table 5.13 lists the known compounds in kraft pulp mill effluent which are acutely lethal at untreated effluent concentration levels, but are not persistent in the receiving environment. These are natural components of the wood which are released by the pulping process. Derivatives of natural

Does this refer to toxicity to aquatic life, human health, or both?

Table 5.13 Principal toxic constituents of kraft mill effluent streams. Constituents are listed in approximate order of prominence. (Adapted from Bonsor et al., 1988).

this is not an accurate title (See last sentence on P.13.

Effluent Stream	Primary Toxic Constituents	Secondary Toxic Constituents
Debarking	Resin acids Isopimaric Dehydroabietic Abietic	Diterpene alcohols Pimarol Isopimarol Dehydroabietal
Pulping (unbleached whitewater)	Sodium salts of resin acids Na isopimarate Na abietate Na dehydroabietate Na pimarate	Sodium salts of unsaturated fatty acids Palmitoleic Oleic Linoleic Defoamers
Acid chlorination	Chlorolignins 4,5-Dichlorocatechol 3,4,5-Trichlorocatechol Tetrachlorocatechol 2,6-Dichlorohydroquinone	Unknown
Caustic extraction	Chlorinated stearic acids Epoxystearic acid Dichlorostearic acid Chlorinated resin acids Monochlorodehydroabietic acid Dichlorodehydroabietic acid Chlorinated phenolics Tetrachloroguaiacol Trichloroguaiacol	Liquid pitch dispersants

acids biodegrade. Dehydroabietic acid, for example has a reported half life of six weeks in water (Taylor and Yeagar, 1987). Resin acids are also nearly insoluble in the water and therefore travel with suspended solids or organic material in the effluent and, consequently a portion of the acids may end up in the sediment with the settled solids. Parameters that affect the fate of unchlorinated organics include processes of dilution, hydrolysis, volatilization, sorption, solubilization and photolysis. Interpretation is further complicated since some proportion of the released compounds end up in the sediment and it is not known whether these sediment bound compounds are available for uptake by aquatic organisms or whether the association with the sediment impedes their breakdown.

all the way Roosevelt Lk

5.2.5 Impacts on Aquatic Life

Evaluation of the impact of the pulp mill's effluent discharge on the aquatic environment requires consideration of direct effects (e.g., acute toxicity, changes to water quality) and indirect effects (e.g., mat buildup on the river bottom eliminating a food source). The evaluation should include an examination of how different trophic levels of aquatic life are affected. This includes:

- Plankton - the community of small or microscopic plants (phytoplankton) and animals (zooplankton) in the water column.
- Periphyton - the community of microscopic plants and animals associated with the surface of submersed substrates.
- Macrophyton - the larger plants which may be attached to the bottom (benthic), free floating, totally submersed or partly emergent vegetation.
- Macro invertebrates - invertebrates larger than 0.5 - 1 mm in size, generally bottom dwellers, or benthos.
- Fish - migratory species such as salmon or sturgeon and resident species such as sculpins.

Phytoplankton, periphyton, and macrophytes, form the base of the aquatic food chain as primary producers, by converting sunlight into biomass using photosynthesis. The phytoplankton community may respond to pollutants by changes in productivity and community structure to tolerant species. However, in flowing water the effect of a specific pollutant may not be evident in the community

The effluent discharge of wood fibres and other solids, and log storage in the area has altered the river bottom for up to one km downstream of the outfall. The build up of solids and wood debris is associated with a slime growth. No detailed studies of macrophyton have been performed. However, earlier diver studies have indicated that the build up of the fibre mat has eliminated vegetation from the river bottom in front of the mill. Early bottom surveys when the mill was starting up reported plant life in regions subsequently covered by the fibre mat.

In most water systems algae/plant growth is limited by low levels of one of the essential nutrients required for growth, usually nitrogen or phosphorous. Addition of the growth limiting nutrient may lead to increased algal production. Some of the identified periphyton (*Sphaerotilus*) grow only in areas of nutrient enrichment, however no algal blooms have been reported in this section of the river (downriver from the pulp mill). No detailed study has been carried out of the algae community in this section of the river and limiting nutrients to determine what concentration will lead to blooms, but algae blooms have not been observed. Tuominen et al. (1987) conducted lab algal assays in 1982 which indicated the limiting nutrient varied from season to season.

In rivers, the relationship between nutrient addition and algae production is influenced by several factors so that there is no absolute maximum value acceptable phosphorous or nitrogen levels to prevent eutrophication. Factors include the physical regime such as river velocity, temperature, light and the amount of grazing by predators.

Studies of the lower Thompson River have suggested that low level additions of soluble reactive phosphorous (equivalent to dissolved phosphorous) will lead to large increases in biomass (Bothwell, 1989). Bothwell (1989) showed that concentrations of 0.3 - 0.6 μg/L of P would saturate specific growth rates of periphytic diatoms in the South Thompson River under extremely stable conditions. The tests were conducted in troughs, with no grazers, which do not represent natural river systems). For periphyton communities, the saturation value is much higher. To further complicate the picture, the algae blooms of the Thompson River of the 1970s and 80s, which inspired study of phosphorous levels have recently disappeared even though phosphorous levels have remained well above 6 μg/L (Bothwell et al., 1989). Possibly, the periphytic, diatoms, periphyton, and grazing communities have increased sufficiently in biomass to remove the nutrients to levels which can no longer inspire algal blooms.

A single sample (Dwernychuk, 1988) indicated that the phosphorous addition from the mill may be important at low river flow with the concentration increasing by 0.008 mg/L P just outside the dilution zone (reduced to +0.004 mg/L P upon complete mixing). The fact that algae blooms have not been observed, indicates that other factors may be controlling nutrients such as fluctuating water

Also such as toxicity

flows. By the time the flow has reached Birchbank, phosphorous levels have dropped to an average of 0.002 mg/L of P (Table 5.12). The existence of periphyton indicates the effluent may not be acutely toxic to plants and algae.

or toxic may partly confo[illegible] by [illegible] enrichme[illegible] The sp[illegible] found were all ind[illegible] of pollutio[illegible]

In 1987, the Celgar mill had an upset which resulted in an overflow of foam/soap from the brown stock washer foam tank to the sewer system and then into the river, which was at low flow. They evaluated the effects of the spill in chronic *Daphnia* (a freshwater zooplankton) bioassays using river water taken downstream of the mill (near the dock of Robson Ferry on the south side of the river). Though no analysis was performed on the river water, the river was assumed to contain higher than usual concentrations of resin acids, sulphides etc. The results of the Chronic *Daphnia* bioassay was that at 100% sample concentration, no evidence of sublethal toxic effects were observed in the first generation reproduction and growth of Daphnids. Kinrade (1989) concluded that reproduction was actually higher in the sample than the control. However, the size of the Daphnids were 2.6% smaller in the test sample. Crozier (1989) noted that there are no zooplankton in the river environment, and so the chronic *Daphnia* test may not reflect the sensitivity of the indigenous species.

Benthic Macroinvertebrates

The effect of the fibre mat on the benthic community may include physical smothering and the release of toxic volatile and organic compounds from the settled solids. Dwernychuk (1988) examined the diversity of species and their richness in the river as an indication of the effect of the mill on the river. Population density figures showed a gradual increase moving downstream from the mill towards the confluence with the Kootenay river. It was suggested that this was because the fibre mat became less dense so that organic enrichment/accumulation from the mill effluent was making this area favourable for organisms tolerant of the effluent. Current practice in biology has been to classify benthic invertebrates as being either sensitive, facultative or tolerant with respect to their ability to withstand pollution.

Sensitive organisms are the first to disappear upon adverse changes in water quality. Included in this category are the mayflies, stoneflies and caddisflies and the aquatic larval stage of insects. These organisms require clean pollutant-free water. Sensitive organisms do not comprise a significant proportion of the Columbia river communities within the habitat from the outfall to the confluence of the Kootenay River.

Facultative fauna consist of a number of organisms such as leeches, midges, water mites ,clams and others. These can tolerate a moderate amount of water quality degradation. Tolerant organisms are more tolerant of toxic conditions, including low concentrations of oxygen, surviving in areas where less tolerant organisms would be eliminated. Tolerant organisms are abundant closest to the outfall and decrease in composition with increasing distance downriver from the diffuser. There is a gradual

In terms of applicability to the receiving environment of the Columbia River, it has been calculated that by the end of the initial dilution zone, dilution of 65:1 has occurred at low flow. Upon complete mixing dilution increases to 126:1 at the lowest river flows. These dilutions are many times higher than the LC50 value and provide a substantial margin of protection against acute toxicity in the fish communities of the river. This is supported by the fact that no fish kills have been recorded.

Do MOE guidelines allow acute toxicity within dilution zones?

Kinrade (1989) examined the effect of mill discharge on the survival of rainbow trout eggs. Specifically, MOE examined the question of whether overgrowth of slime on fish eggs could reduce egg survival by inhibiting the exchange of gases between the egg and the surrounding water (Laws, 1981). The study identified no lethal effects of mill effluent in the river with respect to the development of rainbow trout eggs.

Sublethal Toxicity

While the discharge of effluent may not cause acute lethality in the river, sublethal toxic effects must also be considered. Sublethal effects include effects on reproduction, growth, behaviour and physiology in fish or biota. Bonsor et al. (1988) suggested that if no data is available on the mill effluent's sublethal effects, then a safe concentration would be 0.05 of the LC50. In this instance, with an LC50 of 10% effluent, then concentrations below 0.5% effluent (200:1 dilution) would be the threshold for sublethal effects.

Between the Keenleyside dam and the confluence of the Kootenay River, the average flow provides dilution of over 1000:1. However, when the flow from the dam drops below 250 m^3/s then dilution is less than 200:1 and sublethal effects may occur. The inflow of the Kootenay River increases the river flow so that such minimal dilutions are not observed downstream of the confluence of the Columbia and Kootenay River.

Is this relevant?

A complete risk assessment of specific compounds in the effluent would require consideration of other factors including bioavailability; the duration of exposure; fate processes; and the opportunity of organisms to escape to cleaner water.

A laboratory sublethal study on Celgar Pulp Mill effluent evaluated possible synergistic effects of Celgar mill effluent and nitrogen supersaturation on juvenile rainbow trout (Vigers, 1972). The mill effluent was reported to reduce the supersaturated water, and decreased fish mortalities resulting from supersaturation. No toxic synergistic effects were found.

5.2.6 Downstream Water Users

The pulp mill and the city of Castlegar take their water from a combined pumping station upstream of the dam on Arrow lake. Other communities in the area take their water from groundwater wells or streams flowing into the river. Direct use of the Columbia River as a potable source of water is limited to the village of Warfield, who purchase treated water from Cominco. There are other water users who use well water close enough to the river to be affected by changes to the river water quality (example: the Brilliant community). For downriver users, in particularly Cominco and the village of Warfield, the main problem has been the fibres which have been released by the mill. Tertiary treatment in the form of ultrafiltration is required to remove these very fine fibres. Cominco also cleans their water distribution of system fibres as a regular maintenance feature (Macune, 1989).

Another problem has been foam which has been observed downstream to Trail (Crozier, 1989). An alternate source of foam could be from the dam.

Once complete mixing has occurred at low flow, the water meets Canadian water quality standards for raw water to be used for drinking water supply (CCREM, 1987) and for irrigation (CCREM, 1987) (Table 5.9).

Has the quality of McInnes well [illegible] water be tested?

Throughout the 1970s and 1980s, the most obvious impact of the mill upstream of the confluence of the Kootenay River, has been increased odour and colour in the receiving water. The pulp mill has decreased the aesthetic quality of the water by altering the colour of the river from a natural aqua green to a dark brown. The river has also developed an odour attributed to the volatile organics in the effluent. The economic and aesthetic effects of these changes on recreational activity is difficult to identify and assess, because the mixing and dilution zone in this stretch of the river remains one of the more popular fishing areas, indicating that existing impacts have not been of concern to the angling community.

The reach of river between the dam and the confluence supports a sport fishery. Of concern is that the pulp mill effluent will taint the meat of the fish, spoiling the taste. Kraft mill effluent can cause off flavours in fish, often at levels similar to sublethal effect concentrations (i.e., at 5-10% of 96 h LC50 concentrations). Foul condensates are a major source of tainting compounds in Kraft mill effluent but bleach plants are not (Bonsor et al., 1988). The results of a taste test (B.C. Research, 1977) conducted on the effluent in May and July of 1977 did not show any definitive differences between fish upstream and downstream of the mill. Fish collected downstream from the diffuser were compared to control fish collected from Lower Arrow lake. The three species examined were Kokanee, Rainbow Trout and Largescale Suckers. The results showed that the rainbow trout downstream from the pulp mill were slightly to moderately tainted and in several cases, taste was noted as resembling a pulp mill flavour. The main observation of a July 1976 taste test was a description of an earthy or muddy tastes but both control and test fish were equally tainted. The source of such an earthy or muddy taste was not known, though the fungi *Actinomycetes* was cited as a possible cause (MOE, 1979). There are no data available on levels of fish tainting compounds or fish tasting tests in the 1980s.

Duration of exposure and the effluent concentration are important factors in fish tainting. For example, fish exposed to mill effluent for one hour and then put into clean water may take up to five days to eliminate the taste from their flesh (B.C. Research, 1978). Smith (1987) concluded that evaluation of the effects of local discharges on the fish populations in the Columbia River required more specific knowledge than currently available or the movements and migration patterns of resident fish.

5.3 Expanded Mill

On a per ton of pulp production basis, a combination of process changes and external treatment are designed to reduce or eliminate some of the existing impacts of the mill discharge. The expanded mill will include extended cooking, and oxygen delignification, which coupled to efficient washing will result in greater isolation of the fibres.

- A greater proportion of the toxic compounds, including the tannin and lignins, fatty acids, phenols, and resin acids will be removed from the pulp prior to the bleaching plant. These organic constituents will be burned in the recovery boiler, as opposed to the current practice of sewering.

- The efficiency of the bleaching process will be improved because there will be less interfering organics to react with the bleaching agents and therefore, AOX compounds will be reduced.

- Stripping of the foul condensate from the effluent stream will result in the reduction of volatile organics and organosulfides.

- The introduction of the external treatment system is predicted to substantially reduce resin acid levels in the final effluent. The external treatment system will also reduce other toxic components such that the full strength final effluent will not be acutely toxic (i.e., 96 h LC50 ≥100%).

What about chronic toxicity?

Temperature and pH

With the continued use of the existing plant's neutralization system, the treated effluent after expansion is predicted to have no effect on receiving water pH. The discharge will be 5°C warmer than the existing effluent. Temperature affects effluent buoyancy however, so the plume behaviour may change slightly and the effect of this on mixing of the plume requires further definition. The expected temperature increase in winter time when the receiving water is 0°C and the effluent approximately 35°C, is +0.2°C (assuming heat transfer is almost instantaneous) which would keep the river water temperature within the CCREM (1987) guidelines for protecting fish populations.

Organic Compounds

Toxic compounds will be significantly reduced in the effluent as a result of process changes and the biological treatment system. Resin acid will decrease from a daily loading of 216 kg/d to 28 kg/day, but it is not possible to predict the final effluent concentration of individual resin acids. Phenolics and volatile compounds will be virtually eliminated from the effluent before discharge.

5.3.3 Impacts on Aquatic Life

While there will be substantial improvements to the mill effluent, the improvements to the local environment (in the vicinity of the mill) will be offset, at least partly, by the mill's plans to return to using the river for log storage. The constant handling of the logs will result in bark and wood debris deposits on the river bottom, contributing BOD and leachates to the river water. The significance of these inputs will be dependant on the amount of log storage activity, and cannot be predicted at this time. Similarly, the effect of leachate from the mill yard has not been studied and could be of periodic importance as a source of BOD and leachates to the river. The reduction in wood fibre release should decrease the buildup of the fibre mat on the river bed, and the fibre mat may decrease in size by river erosion.

what ab[illegible]
storm water

The changes in nutrient input, and reduction in colour may have a significant impact on aquatic plants and algae. Similarly, the decrease in toxic components in the effluent may change the macroinvertebrate population to a community of more pollutant sensitive organisms.

A major impact will be the reduction of effluent toxicity such that at low flow mixing, the effluent is predicted to be below concentrations that would exert sublethal effects on fish or other aquatic biota.

Table 6.1 US EPA toxicity equivalents for isomers of chlorinated dibenzodioxins and dibenzofurans (Tappi, 1989).

Does not have guideline

Leave off units; these are relative toxicities independent of specific units.

Isomers	TEQ (Toxic Equivalents) 2378-TCDD pg/g (ng/kg)
2378-TCDF	0.1
Non-2378	0.001
12378-PeCDF	0.1
23478-PeCDF	0.1
Non-2378	0.001
2378-HxCDF	0.01
Non-2378	0.0001
2378-HpCDF	0.01
Non-2378	0.0001
OCDF	0
2378-TCDD	1
Non-2378	0.01
2379-PeCDD	0.5
Non-2378	0.005
2378-HxCDD	0.04
Non-2378	0.0004
2378-HpCDD	0.001
Non-2378	0.00001
OCDD	0

8.0 CONCLUSION AND RECOMMENDATIONS

The EIA has reviewed the operation and discharges of the existing mill, and evaluated the impact of the expanded mill based on predicted emissions and discharges.

Water

It is concluded that the Columbia River has been affected beyond the initial dilution zone of the existing discharges in two respects:

- The Columbia River has been affected by the existing effluent from the mill site to Castlegar Narrows (4 km away). The discharged effluent has affected the river bottom (with a buildup of a fibre mat), and altered the river water quality by changing the colour and discharging odour causing compounds. The mill effluent is not acutely toxic to living organisms in the receiving environment because of dilutions. However, it is unlikely that at low flow (142 m^3/s), the concentration of toxic components, upon complete mixing are sufficient to cause sublethal effects on the aquatic organisms, and possibly result in fish tainting.

At edge of dilution zone?

- Limited testing has indicated that at Birchbank, the Columbia River has assimilated most of the pulp mill effluent. The exceptions to this are: the wood fibres, which clog the water intake pipes at Cominco (near Trail); the mill has also been discharging measurable qualities of chlorinated organic compounds (measured as AOX), including detectable levels of dioxins and furans. River studies have measured furans in the sediment, the water column and in aquatic organisms. Dioxins have been at measurable levels in some fish species. Of the fish sampled, several contained dioxins and furans at levels above that recommended for human consumption.

Identified data gaps include:

- Water quality measurements in the Columbia River have not been adequate to accurately describe current water quality in the vicinity of the mill and the downstream receiving environment.

- In particular, information is needed at low river flow, including mixing/river hydraulic studies, to evaluate the effect of mill effluent discharge on water quality under worst case conditions.

- The measurement of mill effluent characteristics have been confined to regular effluent testing of BOD, suspended solids, temperature, pH and toxicity. Protection of the Columbia River may require more regular, and detailed study of the effluent characteristics including but not limited to determination of levels of chlorinated organics, resin acids, sulphides and colour, and their effects on resident biota.

Is it recommended that a monitoring program be established which includes:

- Monitoring the effluent to ensure the mill meets its permit levels today, and in the expanded mill to ensure the mill effluent meets the design objectives. This includes regular monitoring the levels of those compounds identified as contributing to tainting/odour, and colour change in the river.

- A detailed study of the effluent diffuser to ensure that mixing will be adequate under all flow conditions (in particular, to address ponding of the Columbia because of high flows in the Kootenay River).

- Measuring river water quality at several stations including: upstream, from the mill site but below the dam; at the limit of the initial dilution zone; and downstream from the mill diffuser where mixing is complete (but upstream of the Kootenay River confluence). This should be carried out at regular intervals throughout the year but especially focusing on the times of low flow.

- Better definition of aquatic life in the river environment. This would include studying the plankton, periphyton and plant communities to identify species present, productivity, and the growth limiting nutrient and how aquatic life in the river will react to changing water quality and physical conditions. Similarly the feeding habitats, migration/reproduction patterns of fish in the river should be better defined.

- Definition of activities relating to log storage on the river, ~~and~~ leachate from the mill site (e.g., the chip pile), stormwater runoff, and associated impacts.

Two primary questions which should be addressed in future monitoring programs to fill existing data gaps are:

1. **Will the expanded mill effluent exert sublethal or chronic effects on aquatic organisms in the receiving waters of the Columbia River?**

2. **Are aquatic organisms, particularly sport fish, accumulating levels of dioxins, furans, and other organochlorines compounds that may exceed guidelines for human health?**

A monitoring program to address these issues should include selection of appropriate sampling stations and sentinel species, and analyses of concentrations of potential toxicants in the water column and in the sediments. Sampling stations should be established upstream of the mill below the Keenleyside Dam, at the mill, near the zone of complete mixing, and downstream of the confluence of the Columbia and the Kootenay. Additional stations further downstream may be necessary for large mobile fish, but there is little or no evidence that existing effects of the mill effluent extend past the confluence. The monitoring stations currently used by the BC MOE, or by the mill (e.g., Dwernychuk, 1988), would be suitable. Pre-expansion data could then be compared with post-expansion data for the same or similar sites to determine if predicted improvements occurred.

also at edge of dilution zone

The best organisms to use for monitoring are those associated with the substrate, either living or feeding there. Most toxicants do not persist in the water column but instead accumulate in the sediment. Aquatic invertebrates live in intimate contact with the substrate, and have been used in the past for monitoring studies. The studies conducted by Dwernychuk (1988) are a good example, and similar studies should continue in the future. One possible improvement would be the use of artificial substrates. The composition of the invertebrate community depends heavily on the type of substrate present (Merritt and Cummins, 1978). Thus, similar substrate should be sampled at all stations, but this is not always possible. This problem can be remedied by placing cages or trays of artificial substrate (usually rocks 5-15 cm diameter) in the stream or river. These substrates are readily colonized by invertebrates, and serve to standardize conditions across stations.

sensitive water colu indicator organisms should als be used — i.e. standa short term chronic tests shou be conduc

Aquatic invertebrates are usually too short-lived to accumulate contaminants to a great extent. Thus, they are not suitable for measuring the accumulation and effects of persistent chemicals such as dioxins and furans. The one exception would be clams, the larger species of which may live for 10-15 years (Pennak, 1978). This is presumably why the BC MOE is currently using clams to measure organochlorine levels. Clams are particularly likely to respond to and accumulate contaminants because they feed by filtering the sediment and water. The major problem with using clams for monitoring contaminant levels is that they are almost too immobile as adults. Therefore, there may be considerable variability in tissue concentrations over even a small distance. Based on existing data, tissue levels of organochlorines in clams are more variable than those in fish (Appendix 4).

? Not tr for dioxins

Fish are useful for measuring contaminant accumulation and effects because they are longer-lived and higher up in the food chain than are invertebrates. Both of these factors should increase bioaccumulation, and presumably effects. Tissue levels of contaminants in fish may be less variable than those in clams (see Appendix 4), because tissue levels in the larger and more mobile fish may reflect (i.e., integrate) sediment concentrations over a larger area. The ideal sentinel species would also be benthic, or at least a benthic feeder, relatively immobile, abundant and easily captured. Either the longnose or largescale sucker would be good sentinel species. Rainbow trout and lake whitefish might also be considered because the former is the major sport fish and the latter had the highest furan levels in the study conducted by Mah et al. (1989). Rainbow trout may be too mobile, moving back and forth past the discharge, providing no guarantee that fish caught at a particular station actually spend most of their time there. Rainbow trout are also much less abundant than suckers, or at least much more difficult to capture (see numbers in Table 8.1). Lake whitefish are not abundant according to R.L. & L. Services Ltd. (1984a), but reasonable sample sizes were easily obtained by Mah et al. (1989).

suckers ar not good indicator because c low lipid content —

Sentinel species can be used to monitor sublethal effects at the population level, as well as to monitor contaminant levels in tissue using a monitoring framework known as PISCES (Population Indicators of Sublethal Contaminant Effects on Suckers; Munkittrick and Dixon, 1989a,b). The approach involves comparing demographic characters such as fecundity, body condition, and mean age among populations upstream and downstream of an effluent discharge. Munkittrick and Dixon (1989a,b) were able to show that the status (i.e., declining or increasing numbers) of the affected population, and the pathway of contaminant action (i.e., effects on food or reproduction) could be inferred from these characters. This approach removes the need for expensive estimates of numbers, requires small sample sizes (20-50 females per site), and provides information on impacts at the population level. This type of study can easily be combined with a study of tissue contaminant levels by measuring body burdens in fish samples collected to obtain demographic data.

Any monitoring program comparing, for example, sites upstream and downstream from a discharge, or samples before and after some change, is based on the assumption that differences are caused by the discharge or change. This assumption is strengthened if differences in effects on animals are correlated with differences in concentrations of contaminants produced by the discharge or change. Water quality data similar to that collected by Dwernychuk (1988) should continue to be collected. Data on resin acids, furans, and total organochlorines should also be collected since these are the compounds most likely to have effects.

Table 8.1 Evaluation of species of aquatic organisms which could be used to monitor tissue levels of organochlorines. Y (= Yes) indicate that the organism has the characteristic specified which would make it a suitable species for monitoring.

Characteristic	Species			
	Clam	Suckers	Whitefish	Rainbow Trout
Benthic, or benthic feeders	Y	Y	Y	?
Long-lived	Y	Y	Y	Y
Abundant; easily captured sport or food organisms;	Y?	Y	N?	N
Consumed by humans	N	N	Y?	Y
Immobile, nonmigratory except during spawning	Y	Y	?	N?
Low variability of tissue levels	N	?	Y	?
Suitable for studies of growth, reproduction effects tissue levels	Y?	Y	N?	N
High lipid content				

Y = Yes, N = No, ? = Uncertain.

Based on the points discussed above following recommendations for post-expansion monitoring are made:

1. Population effects on growth and reproduction of aquatic organisms should be monitored to determine if these effects diminish as expected. Existing stations upstream and downstream of the discharge should be used, so that comparisons with existing studies can be made. The future studies should include studies of aquatic invertebrates, similar to those of Dwernychuk (1988), as well as studies of either fish or clams using the PISCES approach.

2. Tissue levels of organochlorines should be measured in samples of fish or clams collected to assess population level effects. Based on the criteria given in Table 8.1, longnose or largescale suckers should be the sentinel species used. Rainbow trout and whitefish are simply not abundant enough to provide the numbers of fish necessary to detect anything other than the grossest effects or elevated tissue levels. However, if the variation of tissue levels of organochlorines in clams can somehow be reduced, they may be the most suitable sentinel species. It is difficult to see how that variation can be reduced, except perhaps by restricting the sampling to one sex and/or age class, or to one sediment type.

3. The number of studies examining levels of furans and dioxins should be restricted to only those that are necessary, in order to reduce costs. For example, if we want to determine the degree to which organochlorine accumulates in sediments or tissue downstream of the mill relative to upstream, and how far downstream the effect persists, we should just monitor AOX levels in suckers. This will reduce costs of chemical analyses by a factor of 10. We must accept that we may never know if the predicted 30% decline in AOX in the discharge results in a comparable decline in tissue or sediment levels. At some point, the level of furans in fish tissue should be determined, preferably in rainbow trout. This should not be done until guidelines are established, and regulatory agencies are clear about the statistical precision required to meet those guidelines. Because concentrations of dioxins and furans are expected to decrease more than those of other compounds, it should be possible to determine if those decreases have in fact led to similar decreases in sediment or tissue levels without using unreasonably large numbers of replicates.

| not necessarily should pick spp. with greatest bioconcentra factor.

4. Monitoring of population level effects and tissue levels should be accompanied by measurements of water quality parameters. Levels of AOX, and furans when appropriate, in sediments should also be monitored.

APPENDIX G

Socio-Economic Impact Study Terms of Reference

Celgar Pulp Company

Celgar Expansion Project
c o H.A. Simons Ltd.
425 Carrall Street
Vancouver, B.C. Canada V6B 2J6

Telephone (604) 664-4709
Fax (604) 664-5469

May 1, 1990

Aldyen Donnelly
MPED Coordinator
Major Project Steering Committee
Ministry of Regional and
Economic Development
Victoria, B.C.

Attention: Ms. A. Donnelly

Dear Aldyen;

As discussed, the following is a brief description of the terms of our socio-economic impact assessment study that we are having conducted by the Columbia Pacific Group.

1. a) Manpower Requirements and Local Participation

   - Review the requirements by skill etc. and assess the ability for local content. Assess measures to maximize local hiring.

   b) Workforce Settlement Issues

   - Examine the various issues concerning large construction camps and their impact on the local community.

   c) Population, Housing and Land Impacts

   - Estimate the increase in local population as a result of the project and assess the need for additional housing.

   d) Impact on Community Infrastructure, Services, and Municipal Finances.

   - Assess the impact on transportation, education, health, police, fire, social services etc.
   - Assess the impact on municipal revenues and expenditures and the timing of same.

e) Local Economic Impact

- Assess the local employment and incomes/expenditure impacts from the construction and operating phases.

We expect to have an interim report available by May 15 - 20th. The final report will be complete by June 9, 1990.

Yours truly,

Wilf Sweeney

WS:lrm

cc: R. Felx
L. Parnell
Mr. Cui
T. Barker
J. Browne
R. Meares
G. Bywater
R. Wigen
J. Lebidoff
F. Parker